STUDY TO COMPARE THE PROGNOSTIC VALUE OF VARIOUS NUTRITIONAL ASSESSMENT TOOLS IN PATIENTS WITH CIRRHOSIS

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I hereby declare that the thesis entitled "**STUDY TO COMPARE THE PROGNOSTIC VALUE OF VARIOUS NUTRITIONAL ASSESSMENT TOOLS IN PATIENTS WITH CIRRHOSIS**" submitted towards partial fulfillment of the requirements for the award of **DM in Gastroenterology** degree to BFUHS is a compilation of original work carried out by me under the supervision of **Dr. Rajoo Singh Chhina**, Former Professor, Department of Gastroenterology and **Dr. Omesh Goyal**, Professor, Department of Gastroenterology. No part of this thesis has formed the basis for the award of any degree previously.

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Dedicated

to

my Family

&

Teachers

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Dr. Ivan Joshi

LIST OF ABBREVIATIONS

ANOVA	Analysis of Variance
BCAA	Branch Chain Amino Acid
BCS	Budd Chiari Syndrome
BMI	Body Mass Index
CHI	Creatinine Height Index
CI	Confidence Interval
CLD	Chronic Liver Disease
CONUT	Controlling Nutritional Status
CTP	Child Turcotte Pugh
ESLD	End Stage Liver Disease
GI	Gastrointestinal
HBV	Hepatitis B Virus
HCC	Hepatocellular Carcinoma
HCV	Hepatitis C Virus
HE	Hepatic Encephalopathy
HG	Handgrip Strength
HIV	Human Immunodeficiency Virus
HRS	Hepatorenal Syndrome
INR	International Normalized Ratio
IL	Interleukin
IVDU	Intravenous Drug User

LCAT	Lecithin Cholesterol Acyltransferase
MAC	Mid Arm Circumference
MAMC	Mid Arm Muscle Circumference
MELD	Model for End Stage Liver Disease
NAFLD	Non-Alcoholic Fatty Liver Disease
NASH	Non-Alcoholic Steatohepatitis
PCM	Protein Calorie Malnutrition
RBP	Retinol Binding Protein
REE	Resting Energy Expenditure
SBP	Spontaneous Bacterial Peritonitis
SD	Standard Deviation
SGA	Subjective Global Assessment
TEE	Total Energy Expenditure
TNF	Tumor Necrosis Factor
TSFT	Triceps Skinfold Thickness

ABSTRACT

Introduction: Malnutrition is highly prevalent in cirrhosis. It increases in frequency with severity of disease and is associated with an increased morbidity and mortality. The diagnosis and treatment of malnutrition in patients with cirrhosis can contribute to a reduction in complications.

Aim: To assess the nutritional status in patients with cirrhosis by different methods, correlate it with the severity of liver disease and compare their prognostic value with the occurrence of cirrhosis related complications.

Materials and methods: This study was conducted among 165 inpatients and outpatients with cirrhosis at Department of Gastroenterology, DMCH, Ludhiana from March 2020 to February 2021 with follow up period of 6 months. Various clinical, biochemical and anthropometric parameters were used for nutritional assessment of cirrhotic patients. The relation between the nutritional status and the severity of disease was assessed. Nutritional tools were compared for their validity in prediction of liver related complications.

Results: Mean age was 49.7 ± 9.2 years and 57.0 ± 8.7 years among males and females, respectively. Most common etiology was alcohol. Nutritional assessment by Subjective Global Assessment (SGA), Creatinine Height Index (CHI) and Controlling Nutirional Status (CONUT) score showed 64.8%, 97% and 99.3 % patients were malnourished, respectively. Mean values of Handgrip strength, Mid arm circumference, Triceps skinfold thickness and Mid arm muscle circumference were significantly low in malnourished patients. Poor nutritional state was seen in advanced stages of cirrhosis. During follow up, complications were seen in 58.2% patients; most common was hepatic encephalopathy. Complications were higher in severely malnourished. SGA was found to be better predictor of complications as compared to other tools.

Conclusion: Malnutrition is high in patients with cirrhosis using different nutritional assessment tools and significantly correlated with the disease severity. It is related to higher incidence of liver related complications.

KEYWORDS*: Cirrhosis, Complications, Malnutrition*

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INTRODUCTION

The term malnutrition is used to describe a deficiency, excess or imbalance of a wide range of nutrients, resulting in a measurable adverse effect on body composition, function and clinical outcomes[1]. Although malnourished individuals can be under- or over-nourished, 'malnutrition' is often used synonymously with 'undernutrition'[2]. It may be a cause or a consequence of disease and exists in institutional care as well as in the community. Most cases of malnutrition in adults are associated with disease and may arise due to reduced dietary intake, reduced absorption of macro and micronutrients, increased losses, altered requirements and increased energy expenditure as in specific chronic diseases[3]. Malnutrition is a common, under-recognised and undertreated problem faced by both patients as well as clinicians.

Cirrhosis is a chronic parenchymal liver disease, defined histologically as a diffuse hepatic process characterised by fibrosis and the conversion of normal liver architecture into structurally abnormal nodules. Chronic liver disease involves a process of continuous inflammation and regeneration that eventually results in permanent fibrosis and cirrhosis. Most common causes of this condition include alcoholic liver disease, hepatitis C and hepatitis B infection and the rapidly increasing incidence of NASH. Alcohol has been reported as the commonest etiological factor for cirrhosis in countries with high alcohol consumption, whereas in countries with low alcohol consumption, viral hepatitis is the most common cause of cirrhosis[4]. The quality of life is abysmal with end stage cirrhosis per se and it is further worsened by complications like infections especially spontaneous bacterial peritonitis (SBP), gastrointestinal bleed, encephalopathy, renal failure and lastly, malignancies[5]. Each of these complications aggravates the pre-existing catabolic state by their impact on circulating cytokines and hormones and results in the reduction of muscle mass.

Liver is essential in maintaining an appropriate nutritional status in healthy individuals through metabolism of proteins, carbohydrates and

fat. In patients with cirrhosis, along with a number of other essential function that liver serves, its role in maintenance of adequate nutritional state is severely impaired. The most common manifestation of impaired nutritional maintenance in cirrhotic patients is protein calorie malnutrition (PCM), which is an independent predictor of mortality[6]. The cause of the morbidity in patients with cirrhosis is multifactorial and one may be attributable to malnourishment. Of those affected by chronic liver disease, approximately 20% with compensated cirrhosis and 65-95% with decompensated cirrhosis have protein calorie malnutrition[7]. Higher degree of malnutrition is associated with lower quality of life[8].

A high prevalence of malnutrition in cirrhosis has been reported in India varying between 47% and 84%[9]. In India there have been estimated 188,575 cirrhosis related death in 2010[10] accounting for 18.3% of global burden of cirrhosis related deaths. The prevalence of malnutrition has been found to be directly proportional with severity of liver disease[11].

Although protein calorie malnutrition leads to a poor prognosis for the liver disease patient, it is commonly undiagnosed due to the complications such as edema and ascites, which make weight change detection more difficult in such patients. Protein calorie malnutrition (PCM) occurs in at least 50% and up to 90% of patients with liver cirrhosis and it further progresses as liver functions deteriorate. Even if PCM is diagnosed in a patient, its importance is often underestimated by the physician and it is usually not considered a medical problem in need of immediate attention. Thus, it is important to realise that malnutrition is an independent risk factor for predicting clinical outcomes in patients with liver disease and is associated with an increased risk of morbidity, biochemical dysfunction, compromised immune function, respiratory function, decreased muscle mass, increased recovery time and delayed wound healing and ultimately, mortality.

Major nutrient deficient in cirrhotic patients is protein[12], though trace elements and vitamins deficiency is also quiet common. Body composition is also altered in chronic liver disease wherein extracellular

fluid volume expands and intracellular fluid volume contracts[13]. Men are more prone for malnourishment, an effect hypothesised due to low testosterone levels in cirrhosis. Alcoholic cirrhotics are more undernourished than post necrotic cirrhosis patients and those with other etiologies. Differences in the cause and severity of disease affect the estimated prevalence of malnutrition in cirrhosis[14]. Reported rates are between 20% for patients with compensated cirrhosis to 100% in hospitalised patients with acute alcoholic hepatitis superimposed on cirrhosis[15]. In patients with cirrhosis, the prevalence of malnutrition characterized by loss of lean body mass and diminished skeletal muscle weight is estimated to be 20% to 60% in different studies[16]. Development of portal hypertension, portosystemic collaterals, and varices are more severe and common in malnourished patients. Thus, prevalence of malnutrition depends primarily on the definition chosen, cause of the liver disease, the stage of the disease, and the methods used to quantify malnutrition.

Malnourishment negatively affects immune system function, respiratory effort, muscle mass and strength and wound healing. There can be a deficiency in cellular and in humoral immunological responses in patients with PCM[17]. In cirrhotic patients, this can contribute to the risk of infections, especially in the urinary tract, lung and peritoneum[18,19]. Undernourished patients also present a decrease in intestinal motility and in digestive enzyme synthesis, as well as intestinal mucosa atrophy[20], delayed healing of wounds, lower quality of life and lower rate of survival, longer hospitalization periods and increased costs[21]. Death rate is high in overtly malnourished. Increased rates of septic complications, poorer quality of life and a reduced lifespan have all been observed in cirrhotics with poorer nutrition status compared to those without. The diagnosis of poor nutritional state and the timely treatment of malnutrition in patients with cirrhosis can contribute to a reduction in frequency and severity of these complications[7].

Considering the high prevalence of malnutrition in patients with cirrhosis, the present study has been undertaken to evaluate the nutritional status

of patients with cirrhosis and to assess the correlation of degree of malnutrition with the severity of liver disease. Also, we aim to study the impact of malnutrition on occurrence of complications of cirrhosis as well as compare the prognostic value of various nutritional assessment tools with the occurrence of these complications.

AIMS AND OBJECTIVES

1. To assess the nutritional status in patients with cirrhosis by different methods including biochemical parameters, anthropometry, muscle strength assessment and subjective global assessment.
2. To study the correlation of the severity of malnourishment with the severity of liver disease.
3. To study and compare the prognostic value of various nutritional assessment tools with the occurrence of cirrhosis related complications.

REVIEW OF LITERATURE

MALNUTRITION

The term ‘Malnutrition’ refers to the deficiencies, excesses, or imbalances in a person’s intake of energy and nutrients. Malnutrition occurs when a person does not have the proper amount of nutrients in the body to function. It involves an imbalance of protein, calories, and other essential vitamins that is required by your body every day to function smoothly. It makes a person vulnerable to increased risk of infections, delayed recovery times, hospitalizations and re-hospitalizations, and death. Malnutrition is a complex entity and is caused by a combination of physical, social, and psychological issues such as: dietary changes with age, poor oral intake, chronic illnesses[3], malabsorption, increased nutrient losses or altered metabolic demands, depression, alcoholism and poor socio-economic status. It is a commonly under-recognised and undertreated condition in both hospitalised and non-hospitalised patients.

The term malnutrition includes three broad groups of conditions: undernutrition, which includes wasting, stunting and underweight; micronutrient-related malnutrition, which includes micronutrient deficiencies (a lack of important vitamins and minerals) or micronutrient excess; and overweight, obesity and diet-related non communicable diseases (such as heart disease, stroke, diabetes and some cancers). However, the term malnutrition is most commonly used to describe undernutrition[2]. Wide range of changes occurs in the physiological functions in malnourished patients leading to increased rates of adverse clinical outcomes, morbidity and mortality.

When considering the pathogenesis and pathophysiology of malnutrition, it is important to distinguish whether malnutrition is unrelated to organic disease, that is, malnutrition is due to environmental factors or dietary habits or related to disease. In the first case, malnutrition mainly results from a decreased dietary intake, which generates an imbalance relative to the nutritional requirements of the

body that may affect not only growth and development, but also other aspects of health. In case of disease-related malnutrition, malnutrition is preceded by a state of inflammation that contributes to the energy imbalance through various mechanisms such as increased catabolism, decreased appetite and increased energy losses[2]. When intake is inadequate in such situations, malnutrition will worsen further and will have a negative impact on the clinical outcomes beyond its intrinsic detrimental effects.

Malnutrition is difficult to recognise and initially it usually occurs gradually, which makes it very difficult to diagnose in the early stages. Certain medical conditions and chronic diseases such as malignancies, chronic renal disease and chronic liver disease, can cause increased requirements or lead to your body being unable to absorb or use nutrients properly. Clinical malnutrition has serious implications on recovery from disease, trauma and surgery and is generally associated with increased morbidity and mortality both in acute and chronic states. Length of hospital stay is significantly longer and higher treatment costs are reported in malnourished patients. Thus, nutritional assessment of each patient is mandatory in order to recognise malnutrition early and initiate timely nutritional therapy.

CIRRHOSIS- OVERVIEW

Cirrhosis of the liver is a devastating condition, commonly the result of decades of chronic inflammation from toxins such as alcohol, viral infections including hepatitis B and hepatitis C virus, immune mediated and autoimmune disease and other pathologies. It is the end stage of progressive liver fibrosis, in which the hepatic architecture is distorted. Historically, viral hepatitis has been the leading etiology for cirrhosis. However, improved prevention strategies (in the case of hepatitis B) and treatment (in the case of hepatitis C) have led to improving chronic liver disease trends. At present, alcohol consumption and obesity, which are common and increasing in many parts of the world, have become key liver disease risk factors. They are anticipated to drive the epidemiology

of chronic liver disease forward and to account for increasing proportions of death in the future.

There are two clinical stages of cirrhosis, compensated and decompensated. In the initial stages, cirrhosis is compensated. Most patients are asymptomatic at this stage, and cirrhosis is usually discovered incidentally during medical encounters for other reasons. Decompensation in patients with compensated cirrhosis is usually defined as the first occurrence of ascites, esophageal variceal bleeding, hepatic encephalopathy, and, in some individuals, increased bilirubin concentration. Patients with decompensated cirrhosis are susceptible to various complications and a reduction in life expectancy[4]. As a result of complex pathophysiological processes associated with cirrhosis, it results in significant morbidity such as gastrointestinal bleeding from portal hypertension, and eventual mortality in many patients.

Cirrhosis is the leading cause of liver-related death globally[22]. Cirrhosis is the eleventh most common cause of death globally[23] and 15th leading cause of morbidity worldwide. A systemic analysis of global burden of cirrhosis showed an increase at the global level since 1990[24]. Liver cirrhosis-related mortality accounts for a substantial disease burden worldwide. Globally, cirrhosis has caused more than 1.32 million deaths in 2017, with 440,000 deaths in females and 883,000 in males, compared with less than 899,000 deaths for both genders in1990, which constituted 2.4% of all deaths globally in 2017 compared with 1.9% in 1990. There are 10.6 million prevalent cases of decompensated cirrhosis and 112 million prevalent cases of compensated cirrhosis globally in 2017. Central Asia has the highest age standardised death rate per 100000 due to cirrhosis for males, females, and both genders combined; with deaths largely driven by alcohol-related liver disease (36.6% of all cirrhosis related deaths).

Cirrhosis is prognostically classified, based on Child Turcotte Pugh Score, into CTP A, CTP B and CTP C, based on bilirubin, albumin, prothrombin time and presence or absence of ascites and hepatic

encephalopathy. On the basis of these parameters, a score of 5-6 points is labelled as CTP Class A, score of 7-9 points CTP Class B and 10 or more points CTP Class C. Model for End stage Liver Disease (MELD) score is also used to classify the severity of liver cirrhosis. It is calculated using bilirubin levels, INR and creatinine levels. Nutritional status can be used as a useful parameter for assessing the prognosis of cirrhotic patients.

MALNUTRITION IN CIRRHOSIS

Liver has essential physiological functions in food digestion, absorption and metabolism of nutrients, playing a central role in the maintenance of a healthy nutritional status. Patients with cirrhosis frequently have varied metabolic abnormalities of carbohydrate, protein and lipid metabolism that lead to gradual deterioration of their health and nutritional status. Imbalance of energy, protein and other nutrients that cause measurable negative effects on the composition of body is labelled as malnutrition. The diagnosis of protein calorie malnutrition (PCM) in cirrhosis is marked by muscle wasting and subcutaneous fat loss. Protein breakdown is prevalent in approximately 20% cirrhotics without any complication. Proper balance should be maintained between anabolism and catabolism of muscle protein to maintain sketelal muscle mass. Sarcopenia, which is also associated with poor outcomes in cirrhosis, is defined as age related disease of skeletal muscle mass and is accompanied by physical inactivity, decreased mobility and poor physical endurance. Age related sarcopenia is primary sarcopenia while cirrhosis associated is a secondary one. It has also been described as a prognostic factor for overall survival in patients with cirrhosis[25].

The presence of protein–calorie malnutrition has been shown to be associated with increased short- and long-term mortality in patients with acute and chronic liver disease. Child and Turcotte classification developed primary prognostic score for liver disease which included nutrition status as a major determining factor for liver disease severity. Abbott et al.[26] investigated the relationship between the Child Pugh classification and nutritional indicators and found that advanced liver

disease (CTP score) was associated with diminished muscle status and increased malnutrition.

Prevalence of malnutrition in chronic liver disease ranges between 10% and 100%, depending on severity of liver disease[6,27]. Malnutrition is prevalent in all forms of liver disease: from 20% in compensated liver disease to more than 80% in those patients with decompensated liver disease[28]. Protein-calorie malnutrition (PCM) can be identified in all clinical stages but is easily observed in advanced stages of liver disease[29]. Many patients, especially those with compensated disease, have only subtle changes such as fat-soluble vitamin deficiency, altered cell-mediated immune function, anemia from iron, folate or pyridoxine deficiency and minimal loss of muscle mass, which makes malnutrition difficult to assess. Patients with end-stage liver disease have more muscle wasting, decreased fat stores and cachexia.

PCM is associated with a number of complications including development of variceal bleeding and ascites, increased surgical morbidity and mortality, reduced survival, and worsening of hepatic function. Patients with cirrhosis may also have micronutrient deficiencies. Recognition of macro- and micronutrient deficiencies is important since supplemental nutrition has been associated with a reduction in the risk of infection and in-hospital mortality and improved liver function parameters. Cirrhosis may further accelerate the development of malnutrition; although nutritional deficiencies are not the cause of cirrhosis but they do contribute to liver dysfunction. Several studies indicate that early aggressive nutritional rehabilitation can actually improve prognosis. Early screening, when malnutrition is less severe, can lead to early treatment and decrease in the occurrence of complications. Liver disease may be the initial catalyst for malnutrition in chronic liver disease (CLD); however, a comprehensive treatment approach for adequate nutrition in addition to the liver disease is necessary to improve clinical outcomes.

There are a number of factors that contribute to malnutrition in hepatic disease such as ascites, encephalopathy, altered gustatory sensations, frequent hospitalizations, increased protein catabolism and insufficient synthesis, malabsorption and maldigestion associated with portal hypertension[30], overzealous diet restrictions, early satiety, nausea, anorexia and low dietary intake[31]. Enteral protein loss and hypercatabolism along with malabsorption of nutrients occurs in cirrhosis due to various reasons including portal hypertension which results in nutrients bypassing the liver without metabolic processing, bacterial overgrowth in the small intestine, cholestasis, intraluminal bile acid deficiency and impaired lipoprotein export. Malnutrition by itself may lead to pancreatic insufficiency which would lead to fat, protein, and carbohydrate malabsorption. Maldigestion may also be due to concomitant chronic pancreatitis among patients with alcohol-related cirrhosis. Thus, malabsorption in cirrhosis is often multifactorial. Liver diseases such as cirrhosis and NAFLD have also been postulated to be associated with an altered microbiome, but the final answers on how the microbiome affects nutrition in these patients are still unknown[32].

EFFECT OF MALNUTRITION ON COURSE OF CIRRHOSIS

Malnutrition has a negative impact on morbidity and mortality in patients with liver cirrhosis and is an important predictor of worse clinical outcomes in patients with advanced cirrhosis[33]. Malnutrition in patients with NAFLD is associated with a higher likelihood of having steatohepatitis or advanced liver fibrosis[33]. Patients with cirrhosis and malnutrition are more likely to develop hepatic encephalopathy, refractory ascites and sepsis-related complications. It is associated with decreased survival, increased treatment-related mortality and tumour recurrence in patients with hepatocellular carcinoma (HCC). In patients awaiting transplant, pre-transplant malnutrition and sarcopenia are associated with increased risk of decompensation, infections and increased waitlist mortality[34]. Post-transplant, these complications predict poorer outcomes and are associated with a longer time to extubation after transplantation, increased post-operative infections,

prolonged ICU stay and hospitalization, and decreased survival[35]. Patients with a worse nutritional status before the transplant have increased incidence of postoperative complications and higher mortality rates.

Sarcopenia, another component of assessment in chronic liver disease; which has been described as a condition of progressive and generalised loss of muscle mass and muscle strength, is also recognised as an independent predictor of poor outcomes and mortality. It has also been studied in other diseases like HIV, chronic heart failure and malignancies. A strong independent association has been confirmed between sarcopenia and mortality in cirrhotic patients by Tandon et al[36], therefore muscle mass and muscle strength loss are one of the diagnostic hallmarks of malnutrition. It has also been seen that adults with CLD showing worse sarcopenia have poor quality of life, more complications of cirrhosis, and worse post-transplant outcomes.

METABOLIC DYSREGULATION IN CIRRHOSIS WITH MALNUTRITION

Patients with cirrhosis frequently have varied metabolic abnormalities. Meuller et al.[37] found raised resting energy expenditure (REE) by indirect calorimetry in 34% of cirrhotic patients. This may be due to increased pro-inflammatory cytokines and abnormalities in carbohydrate, protein and lipid metabolism. Metabolism also increases due to infection, ascites and portal hypertension[38]. Altered carbohydrate metabolism results in reduced synthesis of glycogen in the liver leading to increased gluconeogenesis from protein and fat breakdown[39]. A study by Henkel et al[40], in patients with cirrhosis, has shown that during an overnight fast, 58% of energy came from fat oxidation, whereas healthy controls derived 55% of their energy from carbohydrates.

PROTEIN METABOLISM

Liver in healthy state has a synthetic function of albumin, globulin and fibrinogen synthesis. The liver has a very important role in maintaining muscle homeostasis by maintaining a balance between muscle growth

and degradation. Ammonia production by deamination of amino acids and subsequent conversion to urea occurs exclusively in liver. Amino acids in liver take part in production of glutathione and creatine, an important energy source for skeletal muscles. In cirrhotic patients, gluconeogenic amino acids glutamine and alanine are provided by proteolysis in skeletal muscle, which also contributes to the muscle wasting. Increased level of inflammation leads to increased muscle degradation and overproduction of pro-inflammatory cytokines like adiponectin, interleukin (IL)-6 and tumour necrosis factor (TNF)-alpha, which have fibrogenic and oxidative effects[41]. Autophagy levels are higher in cirrhotics, and alcohol can further stimulate the autophagy pathway[42]. Reduced physical activity also leads to reduction in the release of myokines, which normally help to maintain the muscle mass[43]. The molecular basis of sarcopenia in patients with cirrhosis is centred on the myotoxic effects of hyperammonemia[44]. The proposed mechanism is that ammonia leads to an increase in myostatin via the NF Kappa B pathway leading to reduction in muscle protein synthesis and strength[45]. Moreover, hyperammonemia interferes with the tricyclic acid cycle and reduces ATP generation. The prevalence of decreased muscle strength in cirrhosis is also influenced by alcohol use disorder, a cause of myopathy and non-alcoholic fatty liver disease (NAFLD) in which there are other mechanisms leading to muscle weakness and malnutrition[46]. More branched chain amino acids (BCAAs) are used for energy due to increased protein degradation and turnover and there is an increased muscle uptake of BCAA to detoxify ammonia[47,48]. Thus, there is protein catabolism, decreased urea synthesis, and increased branched chain amino acid utilisation for ketogenesis.

Patients with cirrhosis are in a catabolic state characterized by reduced protein synthesis and enhanced proteolysis to provide fuel for gluconeogenesis. The process of gluconeogenesis requires energy and consequently increases the resting energy expenditure (REE) of patients with cirrhosis[49]. In cirrhosis, being a hypermetabolic state, a relatively higher intake of total energy and proteins are needed. The REE of a

healthy adult is 1 kcal/kg body weight/hour, that is, 24 kcal/kg/day. The total energy expenditure (TEE), of a hemodynamically stable patient with cirrhosis with a sedentary life style is approximately 1.3 times the estimated REE (1.3 x 24 kcal/kg/day, i.e. 32 kcal/kg/day [range 30–35 kcal/kg/day]). Any complication in cirrhosis like infection or gastrointestinal bleed further increases the stress factor and thus, TEE.

While a healthy adult person needs 0.66 gm/kg of proteins every day, the daily protein requirement in patients with cirrhosis is increased to 1.2 gm/kg[50] in the absence of malnutrition or 1.5 gm/kg in the presence of malnutrition[51,52]. The diet should provide around 50–60% of total calories from carbohydrates, preferably complex carbohydrates, and 20–30% from fat. Among fats, saturated fatty acid should not contribute more than 10% of total calories, whereas monounsaturated fatty acids and polyunsaturated fatty acids should contribute equally to the remaining portion of calories provided by fats[53].

GLUCOSE METABOLISM

In healthy individuals, liver maintains plasma glucose levels by gluconeogenesis and gycogenolysis. This homeostasis is maintained by relative concentrations of insulin and glucagon. Raised insulin to glucagon ration inhibits gluconeogenesis and promotes glycogen synthesis, glycolysis and fatty acid synthesis. Cirrhotics have increased frequency of hyperglycaemia and relative hyperinsulinemia[54]. The hyperglycaemia is attributed to decreased glycolysis and reduced glycogen storage in liver and muscle, which is compensated for by increased gluconeogenesis. Also, increased free fatty acids reduce glucose uptake by muscle. Glucagon and catecholamine levels are high which also contribute towards hyperglycaemia. In summary there is decreased glycogen synthesis, increased gluconeogenesis and increased insulin resistance.

LIPID METABOLISM

Liver is the major site of cholesterol degradation and excretion and production of lipoproteins. Hypertriglyceridemia is the most common lipid

abnormality seen in cirrhosis, due to increased fatty acid production and decreased beta oxidation. Lecithin cholesterol acyltransferase (LCAT) production by liver is impaired, causing a reduction in plasma cholesteryl ester levels. Abnormal cell membrane lipids and abnormal erythrocytes like echinocytes are an effect of chronic dyslipoproteinemia. Overall, there is increased lipolysis, fatty acid production and ketogenesis in cirrhosis.

HORMONAL IMBALANCE

Hormonal alterations contribute to alterations in muscle mass and muscle strength. 90% of individuals with cirrhosis have decreased testosterone levels and increased levels of sex hormone–binding globulin, further reducing the level of free testosterone[55,56]. Reduced testosterone levels have been associated with increased mortality in individuals with cirrhosis.

MICRONUTRIENTS

Fat soluble vitamins are deficient because of the decreased synthesis of carrier and transport proteins by liver. Vitamin A deficiency in particular increases the risk of hepatocellular carcinoma in cirrhosis. Vitamin D and Vitamin E deficiencies are seen in approximately 90 % and 50% of cirrhosis patient's respectively[57]. Clinically they manifest as osteoporosis, osteopenia, haemolytic anaemia and increased platelet aggregation. Water soluble vitamins such as thiamine, pyridoxine and vitamin B12 deficiencies are common. Thiamine and folate deficiency occurs much rapidly in those with cirrhosis.

NUTRITIONAL ASSESSMENT IN CIRRHOSIS

Considering that protein calorie malnutrition and micronutrient deficiencies have major prognostic implications in patients with cirrhosis, it is essential to effectively and regularly assess nutritional status among them. It correlates well with short and long term mortality, severity of liver disease appreciated by Child Turcotte Pugh classification (CTP) and Model for End Stage Liver Disease (MELD), liver graft and patient survival after liver-transplantation[58]. Moreover, diagnosing malnutrition

in liver cirrhosis is challenging due to the presence of ascites and oedema.

Nutritional status has been reported as one of the variable that is highly correlated with patients' survival. Also, malnutrition is independent of the disease status therefore it is potentially reversible. Nutritional assessment is vital for early diagnosis of malnutrition, for early intervention to prevent further complications and to monitor impact of management in patient with cirrhosis. Multiple factors need to be analysed in order to make a comprehensive nutritional assessment. Many methods of assessment of nutritional status have been developed to identify malnourished patients or those at risk for malnutrition. Malnutrition by different assessment tools has been found to be significantly associated to various clinical variables like aetiology, CTP (Child Turcotte and Pugh) scores, MELD (Model for End Stage Liver Disease) scores, degree of ascites, blood product usage, blood loss during the surgery, mortality, body composition analysis (fat mass, fat free mass, muscle mass and body fat%), prolonged ventilator support and longer stay in the intensive care unit and hospital[59].

SUBJECTIVE GLOBAL ASSESSMENT

Subjective global assessment (SGA) is one of the most popular methods used in evaluation of nutritional state in patients with cirrhosis. The use of the SGA was recommended by the 2006 guidelines of the European Society of enteral and parenteral Nutrition (ESPEN) together with anthropometric analysis and handgrip strength test (HG) for identifying patients with cirrhosis who are at risk of malnutrition.

Subjective global assessment (SGA) is a simple evaluation tool that allows physicians to incorporate subjective patient history and clinical findings into a nutritional assessment scale. SGA is a standardised array of questions and physical examination findings that are collectively scored to provide a comprehensive rating of nutritional status[60]. The SGA has been shown to be a valid and useful clinical nutritional assessment tool for patients of various medical conditions being graded

into well nourished, moderately malnourished and severely malnourished.

Based on history taking and physical examination, nutritional ratings of patients are obtained as follows: well-nourished as class A, mild to moderately malnourished as class B and severely malnourished as class C. Various features of SGA are analysed to provide the complete nutritional profile of patients. The first is weight loss in the past 6 months. Weight loss of about or <5% has been considered as normal, between 5 and 10% is considered as potential significant weight loss and greater than 10% as highly significant weight loss. The pattern of weight loss is also considered. The second feature considers dietary intake with respect to usual dietary pattern of the patient. Patients are then categorized as normal or abnormal intake. The degree and duration of abnormal intake are also considered (starvation, hypo caloric liquids, full liquid diet and suboptimal solid diet). The third feature is the presence of significant gastrointestinal symptoms like anorexia, nausea, vomiting and diarrhoea. These symptoms should be persisting on a daily basis for more than 2 weeks. Shorter duration of diarrhoea or intermittent vomiting is not considered significant. Vomiting daily or twice daily secondary to obstruction is considered significant. The fourth feature is patient's functional ability from bedridden to full ability to perform daily routine functions. The last feature includes physical examination involving subcutaneous fat and muscle wasting along with presence or absence of ascites or edema due to the underlying disease state.

In a study by Hassan et al[61], 64.4 % of studied patients were malnourished by SGA and class A of SGA was more prevalent in Child A; however SGA class B and C were more in Child C, with significant difference between Child A and B, and Child A and C. SGA has a high specificity (96%) and low sensitivity (22%) for diagnosing malnutrition in cirrhotic patients[62].

Saleh et al[63] used the subjective global assessment (SGA) tool to analyse the nutritional status of 50 patients with chronic liver disease and

correlated the degree of malnutrition of those patients with their laboratory and clinical findings. The results obtained from this study showed that 36% of patients had good nutritional status with SGA score A, 44.0% had mild to moderate nutritional status with SGA score B, while 20.0% of the population had poor nutritional status with SGA score C.

ANTHROPOMETRIC ASSESSMENT

The Body mass index (BMI) is well known anthropometric measure that has been extensively used in assessment of nutritional state of healthy and diseased persons. It is a cheap and convenient objective tool dependent on height and weight. But, presence of ascites and edema make it a non-accurate tool as it overestimates the actual body mass. Cirrhotic patients are volume overloaded; hence mere weight or BMI may not bring out the malnourishment to clinician's view. BMI may be normal in the setting of ascites and edema. Campillo et al[64] found the cut off for BMI in identifying malnourishment in cirrhosis of below 22 Kg/m^2 in the absence of ascites, below 23 Kg/m^2 in the presence of moderate ascites, and below 25 Kg/m^2 in the setting of gross ascites. This cut off has not been validated by others, and varies in different racial backgrounds. In a study conducted by Vishnu Raju et al[65] at Kilpauk Medical college, BMI showed no significant difference and it was in the normal range even though the patients were malnourished. In a study by Tai et al[66], BMI measurements in less malnourished cirrhotic patients were not different from general population, mainly due to the fact that ascites and peripheral edema contributed significantly to body weight.

Mid Arm Circumference (MAC), Triceps skinfold thickness (TSFT) and Mid-arm muscle circumference (MAMC) are relatively inexpensive, non-invasive and simple techniques for body composition assessment[67,68]. These anthropometric measurements may underestimate the prevalence of malnutrition in liver cirrhosis, particularly more so in early phase of the disease[60]. Triceps skinfold thickness is simple, easy to do technique but with subjective variation in measurements. These anthropometric methods can give fallacious estimation in patients with decompensated cirrhosis due to ascites, oedema and low muscle mass.

Triceps skin fold thickness (TSFT) or sub scapular fold thickness is measured as a surrogate marker of subcutaneous fat thickness[69]. Skin fold thickness is measured using specially designed callipers.

Mid Arm Muscle Circumference (MAMC) measures the skeletal muscle mass approximately. However confounding factors of gender and different humerus diameter has to be taken in to account and it is not an accurate predictor of malnutrition when taken as a lone parameter[70]. MAMC is measured from Mid Arm Circumference (MAC) and Triceps Skin fold thickness (TSFT) using the following formula.

$$MAMC = MAC - (0.314 \times TSFT)$$

MAMC and TSFT values less than 5th percentile for a population is considered abnormal and used in diagnosis of malnutrition.

Hand Grip Dynamometry, measured using a hand held Dynamometer, digital or analogue, in units of Kilogram per Force, is an excellent tool in determining depleted fat free mass in cirrhosis. It requires a little alert and co-operative patient[71]. Handgrip strength (HG) is a reliable indicator of functional capacity and is especially useful for following the same patient over time.

Sharma et al.[72] compared several nutritional parameters in adults with liver disease including SGA, MAC, TSFT, and HG. They compared these methods in healthy controls, patients with chronic hepatitis, and patients with cirrhosis. All methods revealed worse signs of malnutrition in patients with cirrhosis. Gaikwad et al[73] conducted a study on 80 patients to assess utility of handgrip strength in predicting short term mortality and various complications in alcoholic liver disease. Handgrip strength came out to be higher in patients having SGA category A than SGA B and C. A strong negative correlation was found between handgrip strength and Child Pugh (CTP) score. In a study by Alvaresda Silva et al[74], HG was found to be more sensitive than SGA in predicting malnutrition and the incidence of major complications at 1 year in cirrhotic patients.

CREATININE HEIGHT INDEX

Creatinine Height Index (CHI) is calculated as amount of 24-hour urine creatinine, corrected for patient's height. It accurately assesses the skeletal muscle mass. The index is calculated from the following formula:

CHI = 24h-urine creatinine excretion (mg) / expected 24h-urine creatinine excretion for height (mg) x 100

If CHI ≥ 80%, there is normal protein status. If CHI 60-80%, there is mild protein depletion; CHI 40-60% and CHI < 40 %, indicate moderate and severe protein depletion, respectively. Creatinine height index is a good method for assessing protein status in cirrhotic patients where sarcopenia is a common complication; however, several factors affect the reliability of CHI, as advanced age results in decreased creatinine excretion and renal impairment reduce the amount of creatinine filtered through the kidney. Trauma, infection, fever, physical activity and catabolic states increase short term creatinine excretion; and incomplete 24 h urine collection will invalidate creatinine excretion results.

In the study by Hassan et al[61], based on CHI, malnutrition was detected in 94.1% patients; 47.5 and 38.6% of patients had mild and moderate protein depletion, respectively and severe protein depletion was found in 7.9% patients. Saleh et al[63] conducted a study among 103 patients with cirrhosis in which according to CHI, malnutrition was present in 89.2% of patients: 11 patients (11.8%) were mildly malnourished, 38 (40.8%) were moderately malnourished and 35 (36.6%) were severely malnourished. The study concluded that CHI is a good predictor of muscle mass in patients with liver cirrhosis.

CONTROLLING NUTRITIONAL STATUS

The Controlling Nutritional Status (CONUT) score is an objective tool that is extensively used to evaluate nutritional status in various diseases[75,76]. The CONUT score is an index calculated from the three laboratory parameters; serum albumin level, total cholesterol level and peripheral lymphocyte count, which are representative markers of protein synthesis, calorie deficiency, and impaired immune defences,

respectively. Because the CONUT score is derived based on the laboratory data using blood samples, clinicians can objectively, simply, and continuously evaluate the nutritional status of the subject[75,76]. Nutritional status assessed by CONUT is classified into four grades of severity: no, mild, moderate and severe malnutrition. A study by Cholongitas et al[77] considered the value of CONUT closely associated with severity of chronic liver disease, and one of the most predictive factors for prognosis in cirrhotic patients. Taniguchi et al[78] assessed 165 patients with chronic liver disease and found that approximately 80% of cirrhotic patients assessed by CONUT have obvious malnutrition. In addition, the value of CONUT was significantly associated with all the anthropometric values such as body mass index, mid-arm circumference, mid-arm muscle circumference, and triceps skinfold thickness.

BIOCHEMICAL PARAMETERS

Pre-albumin (transthyretin), albumin, transferrin and retinol binding protein (RBP) are synthesised by the liver and their levels are low in advanced liver disease. Although nonspecific, they have been used to assess change in nutritional status and stratifying risk of malnutrition. A reduction in serum albumin in the absence of other causes has been shown to represent liver damage and hence forms part of the normal items for a classic liver function test. These parameters can be used in prognostication, but they cannot be used in accurate assessment of nutritional status, as they are more characterised as negative acute phase reactants and indicate underlying inflammation and disease process, rather than the synthetic function of liver[79].

It is always difficult to accurately quantify the nutritional intake in patients; however, there are tools available for the purpose. 24-hour recall, food frequency questionnaire, calorie count and food dairy are some of them. None of them have been validated yet.

PREVALENCE OF MALNUTRITION IN CIRRHOSIS

In the study by Tai et al[66], SGA demonstrated a trend towards more malnutrition in Child-Pugh Class C compared to Child-Pugh Class B liver cirrhosis. Alcoholic cirrhosis had a higher proportion of SGA grade C indicating severe malnutrition (41.7%) compared to viral (26.7%) and cryptogenic (28.6%) cirrhosis, but this was not statistically significant. Serum albumin and transferrin levels were demonstrated to be significantly lower in patients with Child-Pugh Class C liver cirrhosis compared to those with Child-Pugh Class B disease. Caloric intake was further observed to be significantly less in patients with Child-Pugh Class C disease compared to patients with Child-Pugh Class B disease.

Hiroki Nishikawa et al[80] conducted a study to identify the relationship between the CONUT score and clinical parameters among adults with hepatitis C virus (HCV)-related liver cirrhosis. Normal nutritional state was found in 57 patients, mild malnutrition state in 132, moderate malnutrition state in 68 and severe malnutrition state in 7 patients. There were 198 patients in Child-Pugh Class A, 62 in Child-Pugh Class B and 4 in Child-Pugh Class C. This study demonstrated that CONUT score well reflects liver functional reserve.

In a study by Patricia et al[81], 61.5% patients were diagnosed with malnutrition, of which 41% had moderate malnutrition and 20.5 % had severe malnutrition. According to the anthropometric methods that use body weight almost exclusively, the frequency of malnutrition diagnosis was less. By body mass index (BMI), malnutrition was diagnosed in 13 (16.7%) patients, of which nine (11.5%) patients had mild malnutrition, two (2.6%) had moderate malnutrition and two (2.6%) had severe malnutrition. In relating the nutritional state of the patients to the severity of the hepatic dysfunction, a greater number of malnourished and of severely malnourished patients was observed by SGA, respectively, in Child-Pugh Class C and B than in A. Similarly, the determination of % MAC and of % MAMC demonstrated, respectively, a greater number of malnourished patients in Child-Pugh Class C and B than in Class A indicating that the frequency of diagnosis of malnutrition increased

according to the severity of cirrhosis and it also increased in patients with alcoholic cirrhosis.

Daphnee et al[82] conducted a study on ninety three patients to assess malnutrition in liver cirrhosis patients. Out of 93 patients, 46 patients revealed a high incidence of malnutrition as assessed by subjective global assessment and it significantly increased with increasing MELD score, Child Turcotte Pugh (CTP) score and decreasing handgrip strength. The study concluded that handgrip strength is a reliable, non-invasive and cost effective tool to identify malnutrition in cirrhotic patients and low handgrip strength (≤19.5 Kg/F) was a very strong indicator of mortality and there was at least eight times higher mortality than those having hand grip strength above 19.5 kg/F.

Rebecca Luong et al[83] conducted a prospective study on 42 outpatients with liver cirrhosis and demonstrated the prevalence of malnutrition to be 40% according to SGA. Patients who were malnourished according to SGA had lower median handgrip strength (HG) of normal than those who were malnourished. Patients who were well nourished had a high distribution in the upper percentiles for TSFT, MAC and MAMC with all measurements equal to or greater than the 10th percentile. Most patients who were malnourished were distributed in the lower percentiles for TSFT, MAC and MAMC with only a few patients above the 75th percentile. As in other studies, there were a higher proportion of patients with Child-Pugh Class B or C who were malnourished compared to Child-Pugh Class A.

Bakshi et al[84] recruited 54 patients with end stage liver disease (ESLD) and found that majority of the patient were moderately malnourished (75.8%), about 9.1% of the patients were severely malnourished and only about 15.2% of the patients had normal nutritional status. The CTP scores showed significantly higher moderately malnourished patients in Class C than A and B whereas MELD Scores did not present any significant relation with nutrition status. Also, patients with moderate and severe malnutrition had significantly tense ascites than normal patients.

Mid Arm Circumference (MAC), Mid Arm Muscle Circumference (MAMC), present body weight and BMI did not show any significant relation with nutrition status assessment by SGA among ESLD patients showing that only physical examination by anthropometric measurements might not be reliable as a nutritional assessment tool for these patients. However, Triceps skin-fold thickness (TSFT) measurement showed significantly normal triceps levels in moderate malnutrition depicting no effect of malnutrition on triceps skin fold thickness.

In a study by Maharshi et al[85] among 247 patients, prevalence of malnutrition was 59.5% according to traditional model and 71.4% by handgrip. Prevalence of malnutrition was 12/27 (44.5%), 96/131 (73.3%) and 84/89 (94.4%) in CTP class A, B, and C respectively. Complications requiring hospitalization and mortality were more in malnourished patients compared to well nourished. Creatinine height index (CHI) showed a significant correlation with liver disease severity as assessed by Child–Pugh score and MELD score; thus, nutritional assessment parameters significantly correlated with the liver disease severity.

In a study by Nunes et al[86] among 130 cirrhosis patients, nutritional assessment performed using SGA showed 77 (59%) patients being considered well nourished, 40 (31%) patients being moderately malnourished and 13 (10%) patients being severely malnourished. Ten (8%) patients with a low BMI were considered malnourished and 120 (92%) patients displayed normal or high BMI. There was an association between severity of liver disease and SGA, since patients in CTP Class B and Class C were more frequently mild to moderate and severely malnourished on being compared with SGA, respectively. During the follow-up period, a low mortality rate was found as only 19% of patients died at the end of the study. All deaths were associated with liver disease progression, with most patients having advanced liver disease and moderate-to-severe malnutrition according to SGA.

Sharma et al[72] conducted a study in which according to SGA, 24% patients with chronic hepatitis and 56% of patients with cirrhosis had malnutrition. In patients with chronic hepatitis, prevalence of malnutrition according to MAMC, TSFT and HG was 12%, 31% and 18%, respectively as compared to patients with cirrhosis in which prevalence of malnutrition according to MAMC, TSFT and HGS was 27%, 60% and 42%, respectively. Handgrip strength had the highest area under curve (0.82) compared to MAMC (0.60) and TST (0.65) for assessing malnutrition. On comparison of HG, TSFT and MAMC, the sensitivity was 67%, 60% and 31%, respectively, specificity was 95%, 71% and 89%, respectively, and diagnostic accuracy was 87%, 67% and 71%, respectively.

Nutrition intervention has been reported as a crucial factor for the recovery of malnourished cirrhotic patients. Since these patients are at a higher risk for nutritionally mediated complication, therefore nutrition interventions are considered comparatively cost-effective during the preoperative period of liver transplant. It is therefore important to identify and correct nutritional deficiencies in patients with cirrhosis[86-89].

Liver disease has varied etiology which affects conventional markers of nutrition, like serum proteins levels synthesized by the liver (albumin, transferrin, retinol-binding protein) and immunological dysfunction. The accurate nutritional status assessment in these patients is difficult, mainly because of overlap with other complications like fluid retention and hypoproteinemia. Irrespective of these problems in nutrition assessment, malnutrition can be assessed in 20% of patients with compensated liver disease and in >80% with decompensated liver disease[90].

To summarise, metabolic dysregulation and malnourishment in cirrhosis is a common entity, and it negatively impacts the course of cirrhosis and leads to increased mortality. It results in higher complication rates like ascites, encephalopathy, infections and kidney injuries. These often lead to increased mortality in cirrhotics with malnutrition than without

malnutrition. The degree and prevalence of malnutrition is generally directly proportional to the disease severity, being higher in decompensated cirrhosis[5]. Early identification can be helpful in providing medical nutritional therapy in cirrhosis, thereby reducing the morbidity and mortality. Currently, there is no consensus about the best method for quantification and classification of malnutrition in cirrhosis. Thus, there is need to find an ideal, easily available and inexpensive method to categorise malnutrition in patients with liver cirrhosis.

MATERIALS AND METHODS

Study centre: Department of Gastroenterology, Dayanand Medical College & Hospital, Ludhiana.

Type of study: Prospective study

Period of Study: March 2020 to February 2021 with follow up period of 6 months till August 2021

Study population: Inpatients and outpatients in Department of Gastroenterology, DMCH, Ludhiana

Inclusion criteria:

1. Age 18-65 years of age
2. Cases of cirrhosis, diagnosed by clinical, biochemical and imaging parameters, of all etiologies.

Exclusion criteria:

1. Hepatic encephalopathy
2. Active gastrointestinal bleeding
3. Sepsis
4. Acute liver failure
5. Suspected hepatocellular carcinoma
6. Chronic diarrhoea
7. Chronic kidney disease
8. Patients with chronic debilitating diseases and malignancies

Methodology:

The study enrolled both indoor and outdoor patients of liver cirrhosis evaluated at Dayanand Medical College and Hospital, Ludhiana, aged between 18-65 years who fulfilled the inclusion and exclusion criteria. Baseline demographic values and personal information regarding residence, smoking and drinking habits, presenting complaints, and presence of any comorbidity or past medical history were recorded. Hematological parameters such as complete hemogram and

prothrombin time and biochemical parameters such as liver function tests including bilirubin and albumin, renal function tests and lipid profile were done. Etiological workup of cirrhosis including viral markers were done. 24-hour urinary creatinine was measured. Presence or absence of ascites was analysed clinically and using ultrasound abdomen. Ascites was graded according to the amount of fluid accumulated in the abdominal cavity. Mild ascites was only detected by ultrasound. Moderate symmetric distension of abdomen on clinical examination was categorised into moderate ascites while marked distension of the abdomen was labelled as gross ascites [91]. Diagnosis of cirrhosis was based on clinical, biochemical and imaging findings. Weight and height of the patients were recorded and body mass index was calculated thereafter.

Severity of liver disease was determined by Child Turcotte Pugh (CTP) score and MELD score. CTP score is based on five parameters: serum bilirubin, serum albumin, ascites, hepatic encephalopathy and prothrombin time.

Score	**1**	**2**	**3**
Bilirubin (mg/dl)	<2	2-3	>3
Albumin (g/dl)	>3.5	2.8-3.5	<2.8
Encephalopathy	None	Grade 1-2	Grade 3-4
Ascites	None	Mild/moderate	Severe
Prothrombin time (seconds prolonged)	<4	4-6	>6

Each clinical measure included in Child Turcotte Pugh classification is scored from 1-3 points, with 3 points indicating most severe derangement. On the basis of this, a score of 5-6 points is labelled as CTP Class A, score of 7-9 points CTP Class B and 10 or more points CTP Class C.

Model for End stage Liver Disease (MELD) score includes serum bilirubin levels, INR and serum creatinine. In patients with cirrhosis, an

increasing MELD score is associated with increasing severity of hepatic dysfunction.

Nutritional status was determined for each patient by means of:

I. **Anthropometric measurement**:

a) Mid arm circumference (MAC): measured with inch tape at a midpoint between acromian process and olecranon in the relaxed non dominant arm
b) Triceps skin fold thickness (TSFT): The site midway was located between acromial (shoulder) and elbow. The skin folds were grabbed as vertical folds at the posterior median line and pulled away from the muscles. Millimetres of the skinfold were measured with callipers.
c) Mid arm muscle circumference (MAMC): It is calculated by using the formula MAMC = MAC in cm - (TSFT in mm x 0.314)
d) Body Mass Index (BMI): calculated as Weight (in Kg)/height (in metres^2) corrected for overweight estimation due to ascites. There is no validated method to adjust BMI in patients with cirrhosis which may be inaccurate in presence of ascites and edema. Dry body weight was calculated by reducing the ascites weight from the actual body weight to minimize the error. Depending upon the severity of ascites, 5% was subtracted from the actual body weight if mild ascites was present, 10% was subtracted if ascites was moderate and 15% if severe ascites was there, with an additional 5% subtracted if bilateral pedal edema was present [92]. BMI was categorised into underweight (< 18.5 kg/m^2), normal weight (18.5 to 24.9 kg/m^2), overweight (25 to 29.9kg/m^2) and obese (30 kg/m^2 or more).

II. **Hand grip strength (HG)**: It was assessed with Jamar hand grip dynamometer. HGS was measured with the subject in the seated position, shoulders adducted and neutrally rotated, elbow flexed at 90° with the forearm and wrist in a neutral position. The patient was asked to squeeze the dynamometer with dominant hand for 3-5 seconds as

hard as possible. Average of three readings taken at an interval of 5 minutes was taken as final value expressed in Kg/F.

III. **Subjective Global Assessment score (SGA)**: SGA is based on history, physical evaluation and SGA rating. The history included weight change, dietary intake, gastrointestinal symptoms, and functional capacity of work. Physical examination included loss of subcutaneous fat, muscle loss, detection of ankle oedema and ascites. All patients were classified into SGA A, SGA B, or SGA C based on the score. SGA 'A' were well nourished, 'B' were mild to moderately malnourished and 'C' severely malnourished.

IV. **Creatinine–height index (CHI):** 24-hour urinary creatinine was measured and compared with the values expected for the same height. The index was calculated from the following formula:
CHI = 24-h-urine creatinine excretion (mg) / expected 24h-urine creatinine excretion for height (mg) x 100

The results were interpreted as follows:

a) CHI ≥ 80%: normal protein status
b) CHI 60-80%: mild protein depletion
c) CHI 40-60%: moderate protein depletion
d) CHI <40%: severe protein depletion

V. **Controlling nutritional status (CONUT):** It consists of three parameters, serum albumin, total cholesterol, and total lymphocytic count. Nutritional status assessed by CONUT was classified according to the total score into four degrees of severity as shown in table. Score of 0-1 is labelled as no malnutrition, score of 2-4 as mild malnutrition, score of 5-8 as moderate malnutrition and score of 9-12 as severe malnutrition.

Parameter	Normal	Mild	Moderate	Severe
Serum albumin (g/dl)	3.5-4.5	3.0-3.49	2.5-2.9	<2.5
Score	0	2	4	6
Total cholesterol (mg/dl)	>180	140-180	100-139	<100
Score	0	1	2	3
Total lymphocyte count (/mm^3)	≥1600	1200-1599	800-1199	<800
Score	0	1	2	3

Based on anthropometric, biochemical, muscle strength assessment and subjective global assessment, patients with cirrhosis were classified into as mild, moderate and severe degree of malnutrition. The relation between the nutritional status and the severity of disease was assessed. Patients were followed for a period of 6 months for development of cirrhosis related complications. Nutritional tools were compared for their prognostic value in relation to the occurrence of complications of cirrhosis.

Statistical Analysis:

Data were described in terms of range; mean ± standard deviation (± SD), frequencies (number of cases) and relative frequencies (percentages) as appropriate. Comparison of quantitative variables between the study groups was done using ANOVA. For comparing categorical data, Chi square ($\chi 2$) test was performed and exact test was used when the expected frequency is less than 5. Logistic regression analysis was used for analysis of independent factor with the outcome of the patients. A probability value (p value) less than 0.05 was considered statistically significant. All statistical calculations were done using (Statistical Package for the Social Science) SPSS 21version (SPSS Inc., Chicago, IL, USA) statistical program for Microsoft Windows.

OBSERVATION AND RESULTS

One hundred sixty five patients of both genders with cirrhosis of various etiologies evaluated at Dayanand Medical College and Hospital, Ludhiana were enrolled in our study. Mean age among males and females were 49.76 ± 9.28 years and 57.0 ± 8.77 years, respectively.

Table 1: Age wise distribution of study group

Age group (Years)	No. of cases	Percentage
< 30	5	3.0
31-40	11	6.7
41-50	67	40.6
51-60	53	32.1
> 60	29	17.6

Age wise distribution of study group is depicted in table 1 and figure 1. Majority of the study group, 40.6% (n=67) patients, belonged to the 4th decade. 32.1% (n=53) and 17.6% (n=29) patients belonged to 5th and 6th decade, respectively. 6.7% (n=11) patients were in the age group of 31-40 years and only 3% (n=5) were less than 30 years of age.

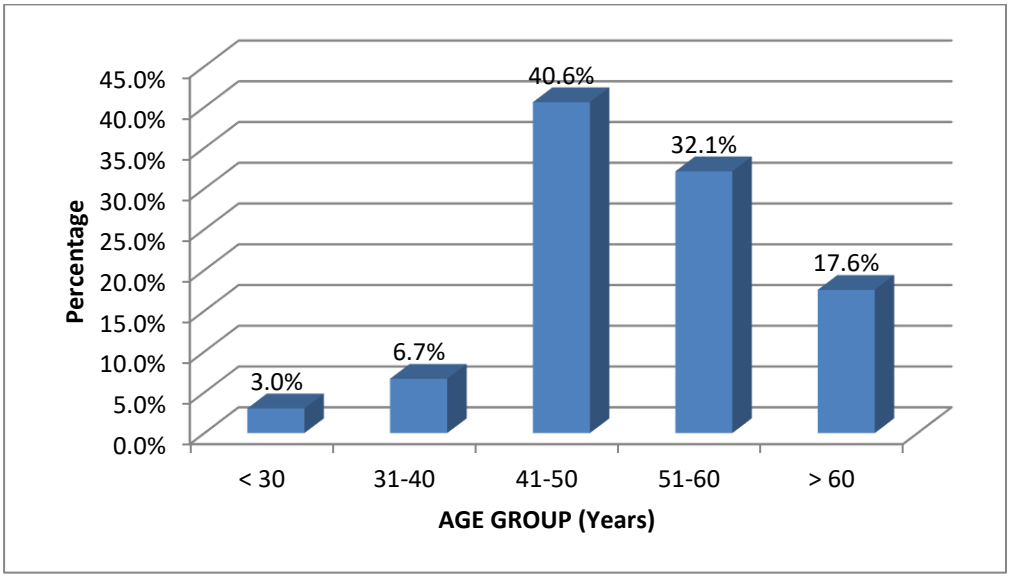

Figure 1: Age wise distribution of study group

Table 2: Demographic data of the study group

Gender	No. of cases	Percentage
Male	140	84.8
Female	25	15.2
Background		
Rural	99	60.0
Urban	66	40.0
Alcohol		
Yes	94	57.0
No	71	43.0
Smoking		
Yes	39	23.6%
No	126	76.4%
IVDU		
No	165	100.0%

Males constituted maximum percentage of the study group i.e.140 were males (84.8%) and 25 were female patients (15.2%). 60% of the study group resided in the rural areas while 40% were from urban background. Demographic data of the subjects is presented in table 2. Consumption of alcohol was found to be common in our study, and was seen in 57% (n=94) patients, all were males. Also, 39 subjects i.e. 23.6% were having habit of smoking.

Table 3: Etiologic distribution of cirrhosis in the study group

Etiology	No. of cases	Percentage
Alcohol	69	41.8
NASH	58	35.2
Alcohol + NASH	16	9.7
Alcohol +HCV	8	4.8
NASH + HCV	3	1.8
Hepatitis B	3	1.8
Hepatitis C	3	1.8
Alcohol + HBV	2	1.2
NASH + HBV	1	0.6
Autoimmune	1	0.6
Budd Chiari Syndrome	1	0.6

In our study, most common etiology of cirrhosis was found to be alcohol. It alone contributed as the etiology in 41.8% (n=69) of the cases of cirrhosis followed by NASH seen in 35.2% (n=58) cases. Both alcohol and NASH together led to cirrhosis in 9.7% (n=16) of the study group. Cirrhosis secondary to Hepatitis C virus and Hepatitis B virus, as a single causative factor, contributed only 1.8% (n=3) cases each while the percentage of patients with Hepatitis C infection who consumed alcohol was higher, i.e. 4.8%. Various etiologies of cirrhosis in our study are shown in table 3 and figure 2.

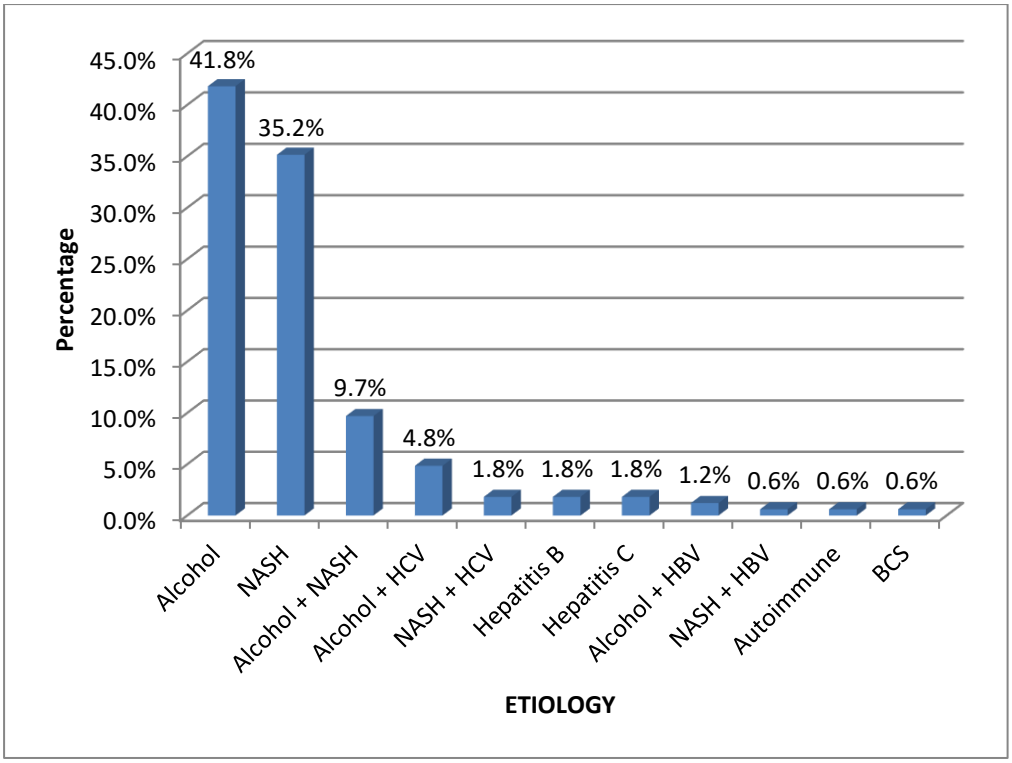

Figure 2: Etiologic distribution of cirrhosis in the study group

Table 4: Presence of ascites in the study group

Ascites	No. of cases	Percentage
No	60	36.3
Mild	44	26.7
Moderate	43	26.1
Gross	18	10.9

Ascites is defined as presence of fluid in the abdominal region and is one of the important complications of cirrhosis. As there is increase in the amount of ascites in the abdomen, the severity of liver disease rises as well. Among the study subjects, ascites was seen in 105 patients while 60 patients had no ascites as shown in table 4. It was differentiated into mild ascites, moderate ascites and gross ascites. 44 subjects were found to have mild ascites, whereas 43 and 18 subjects were having moderate and gross ascites, respectively.

Table 5: Severity of cirrhosis in the study group by CTP classification

CTP Class	No. of cases	Percentage
A	38	23.0
B	73	44.2
C	54	32.7

Severity of liver disease was assessed by calculating Child Turcotte Pugh (CTP) score, categorised as CTP A, B and C. CTP score is calculated by taking into consideration various parameters such as bilirubin levels, albumin levels, INR, presence and absence of ascites and hepatic encephalopathy and on the basis of this, a score of 5-6 points is labelled as CTP Class A, score of 7-9 points CTP Class B and 10 or more points CTP Class C. CTP scores of all patients have been presented in table 5 and figure 3. On the basis of the CTP scores, majority of the patients were in CTP Class B, i.e., 44.2% (n=73). 32.7% (n=54) patients of the study group were in CTP Class C followed by CTP Class A having 23% (n=38) patients. Thus, it was concluded that majority of the subjects in our study were having moderate disease severity.

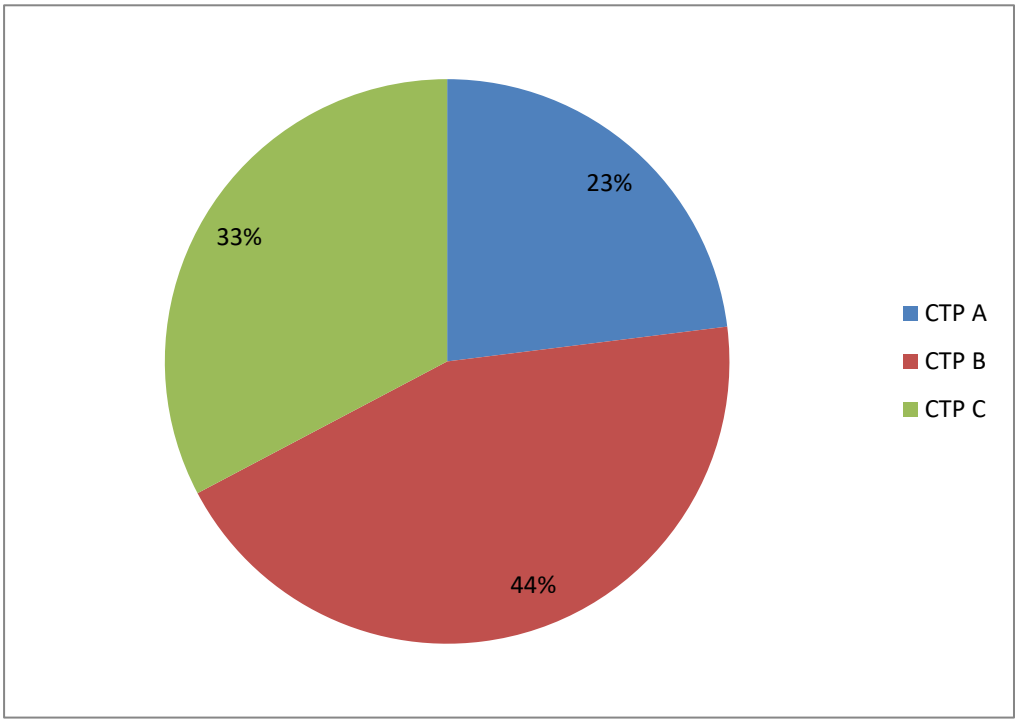

Figure 3: Severity of cirrhosis in the study group by CTP classification

Table 6: BMI distribution of the study group

BMI (Kg/m^2)	No. of cases	Percentage
< 18.5	16	9.7
18.5-24.9	78	47.3
25-29.9	53	32.1
> 30	18	10.9

The BMI is a well known anthropometric measure used in nutritional assessment of healthy and diseased persons. It is a cheap and convenient objective tool dependent on height and weight. BMI was calculated in our study from dry weight of the patient. Dry body weight was calculated by reducing the ascites weight from the actual body weight. Depending upon the severity of ascites, weight percentage was subtracted, 5% was subtracted from the actual body weight in case of mild ascites, 10% was subtracted if ascites was moderate and 15% was subtracted if severe ascites was there. 9.7% (n=16) patients were undernourished according to BMI while majority of the patients i.e. 47.3% (n=78) had normal BMI as represented in table 6. Rest of the subjects are overweight and obese.

Table 7: Association of BMI and severity of liver disease in the study group

	CTP Class						Total	p-value
BMI(Kg/m^2)	**A**	**%**	**B**	**%**	**C**	**%**		
< 18.5	1	6.3	7	43.7	8	50	16	
18.5-24.9	12	15.4	39	50	27	34.6	78	0.003*
25-29.9	23	43.4	18	34	12	22.6	53	
> 30	2	11.1	9	50	7	38.9	18	

***significant**

In our study, 50% (n=8/16) patients who were undernourished belonged to CTP Class C and 43.7% (n=7/16) belonged to CTP Class B while only 1 patients among those with BMI <18.5 Kg/m^2 was of CTP Class A. 34.6% (n=27/78) patients had normal BMI in those with CTP Class C and 50% (n=39/78) patients with normal BMI belonged to CTP Class B. Majority of patients with CTP Class A were overweight. Association of BMI among the study group and severity of liver disease is shown in table 7 and figure 4.

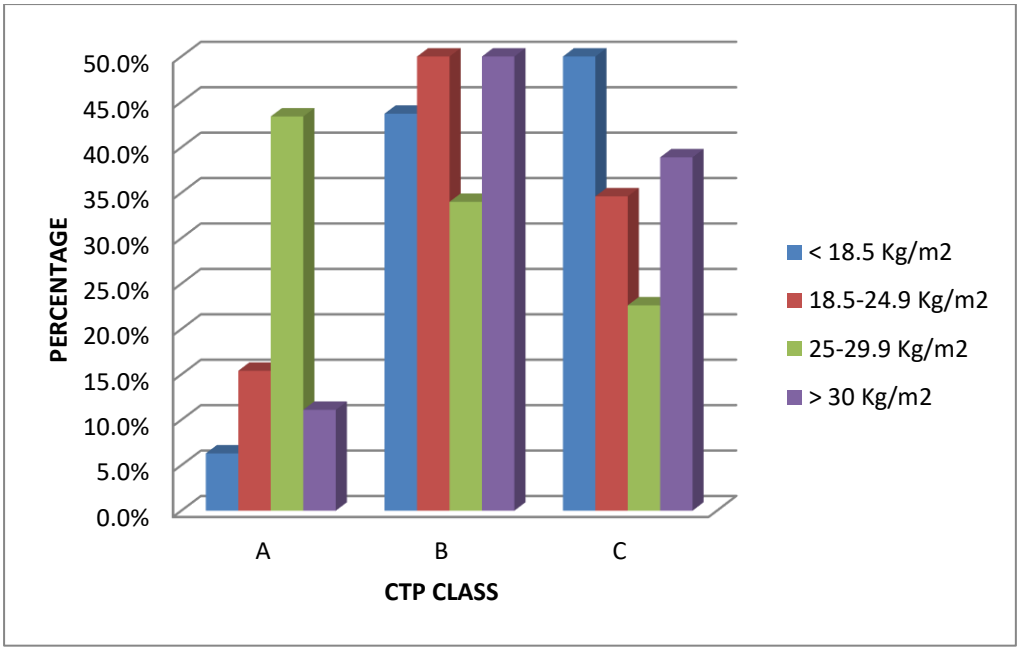

Figure 4: Association of BMI and severity of liver disease in the study group

Table 8: Nutritional status of the study group according to Subjective Global Assessment (SGA)

SGA	No. of cases	Percentage
A	58	35.2
B	85	51.5
C	22	13.3

The Subjective Global Assessment Score is an important tool for assessing malnutrition in liver cirrhosis. It categorises patients into SGA Class A, B and C, where A means well nourished, B means mild to moderate malnutrition and C points to severe malnutrition on the basis of weight change, dietary intake, gastrointestinal symptoms, physical status and functional capacity, muscle wasting and metabolic stress. Accordingly, maximum number of patients were mild to moderately malnourished, i.e. 51.5% (n=85) in SGA Class B. 35.2% (n=58) patients were well nourished (SGA Class A) and 13.3% (n= 22) had poor nutritional status (SGA Class C). SGA Class A points to well nourished; hence cumulatively 107 patients (64.8%) were malnourished. Table 8 represents results obtained from Subjective Global Assessment questionnaire.

Table 9: Association of BMI with nutritional status of the study group

	SGA						Total	p-value
BMI (Kg/m^2)	A	%	B	%	C	%		
< 18.5	1	1.8	6	7	9	41	16	0.0001*
18.5-24.9	25	43.1	42	49.4	11	50	78	
25-29.9	26	44.8	26	30.6	1	4.5	53	
> 30	6	10.3	11	13	1	4.5	18	

*significant

In our study, among well-nourished subjects according to SGA Class, most of the subjects have normal BMI or in the higher range. In patients with SGA Class B, only 7% (n=6/85) patients had BMI less than 18.5 Kg/m2 and 49.4% (n=42/85) had normal BMI. In patients with SGA Class C, 40.9% (n=9/22) patients were undernourished according to BMI and 50% (n=11) patients have normal BMI (p value < 0.0001). Association of BMI among the study population with nutritional states according to SGA Class is depicted in Table 9 and figure 5.

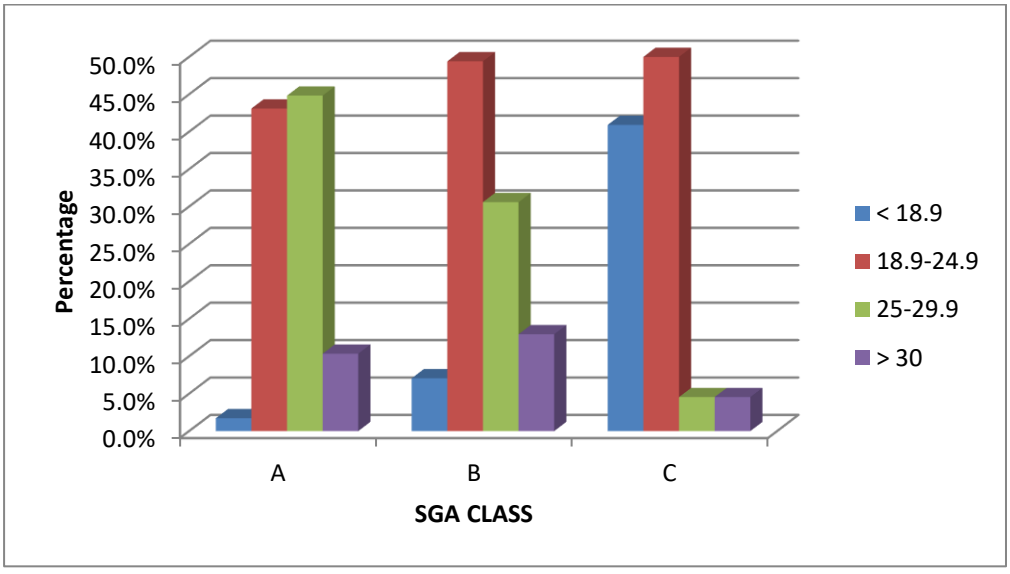

Figure 5: Association of BMI with nutritional status of the study group

Table 10: Association of mean values of Handgrip strength (HG), Mid Arm Circumference (MAC), Triceps skin Fold Thickness (TSFT) and Mid Arm Muscle Circumference (MAMC) of the study group with severity of liver disease

CTP Class	**A**	**B**	**C**	p-value
HG (Kg/F)	27.89 ± 5.78	22.62 ± 5.55	21.01 ± 3.76	0.001*
MAC (cm)	24.88 ± 2.37	23.49 ± 2.70	23.02 ± 2.52	0.003*
TSFT (mm)	11.52 ± 1.65	10.58 ± 3.06	9.44 ± 2.00	0.001*
MAMC (cm)	21.23 ± 2.08	20.11 ± 2.52	19.78 ± 2.84	0.024*

*significant

The means of Handgrip strength, Triceps skinfold thickness (TSFT), Mid Arm circumference (MAC) and Mid Arm muscle circumference (MAMC) were compared between Child Class A, B and C. There was a statistically significant difference (p value = 0.0001) between the three Child Pugh Class groups in regards to Handgrip strength, Triceps skinfold thickness (TSFT), Mid Arm circumference (MAC) and Mid Arm muscle circumference (MAMC) as shown in table 10 and figure 6. Values were significantly low in severe disease (CTP Class C) as compared to early stages.

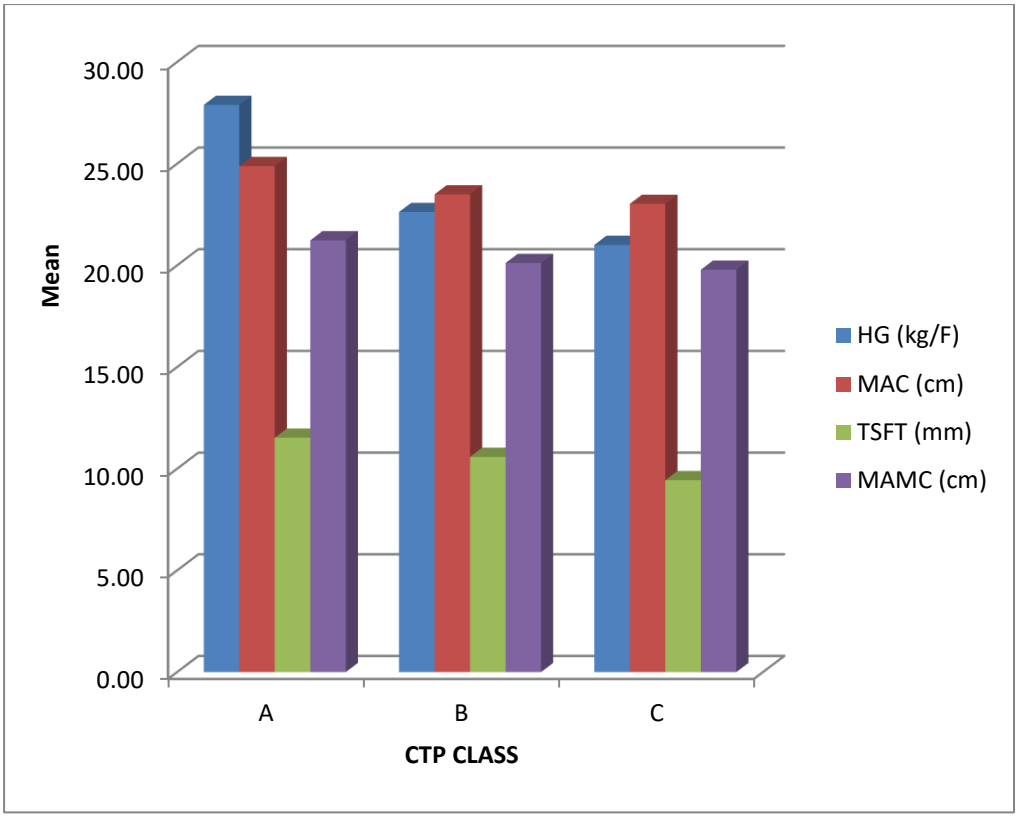

Figure 6: Association of mean values of Handgrip strength (HG), Mid Arm Circumference (MAC), Triceps skin Fold Thickness (TSFT) and Mid Arm Muscle Circumference (MAMC) of the study group with severity of liver disease

Table 11: Association of mean values of Handgrip strength (HG), Mid Arm Circumference (MAC), Triceps skin Fold Thickness (TSFT) and Mid Arm Muscle Circumference (MAMC) of the study group with the nutritional status

	SGA			p-value
	A	**B**	**C**	
HG (Kg/F)	27.61 ± 5.13	22.09 ± 3.96	16.64 ± 3.91	0.0001*
MAC (cm)	24.88 ± 2.44	23.62 ± 2.25	20.57 ± 2.05	0.0001*
TSFT (mm)	11.61 ± 1.57	10.33 ± 2.84	7.66 ± 1.02	0.0001*
MAMC (cm)	21.18 ± 2.14	20.33 ± 2.18	17.56 ± 3.27	0.0001*

***significant**

Hand grip strength is determined with the help of Jamar dynamometer and it has been considered as one of the best bedside tool for malnutrition assessment. Muscle mass is evaluated based on the measurements of Triceps skinfold thickness (TSFT), Mid Arm circumference (MAC) and Mid Arm muscle circumference (MAMC). The Anthropometric data and Hand grip strength were measured and documented and tabulated against SGA group A, B and C, to obtain the significance of difference between well-nourished and malnourished. On the basis of the data that has been collected, as represented in table 11 and figure 7, there was a statistically significant correlation found between SGA Class and Handgrip strength (p value = 0.0001), Mid Arm circumference (MAC) (p value = 0.0001), Triceps skinfold thickness (TSFT) (p value = 0.0001) and Mid Arm muscle circumference (MAMC) (p value = 0.0001). Values were significantly low in malnourished patients compared to well nourished.

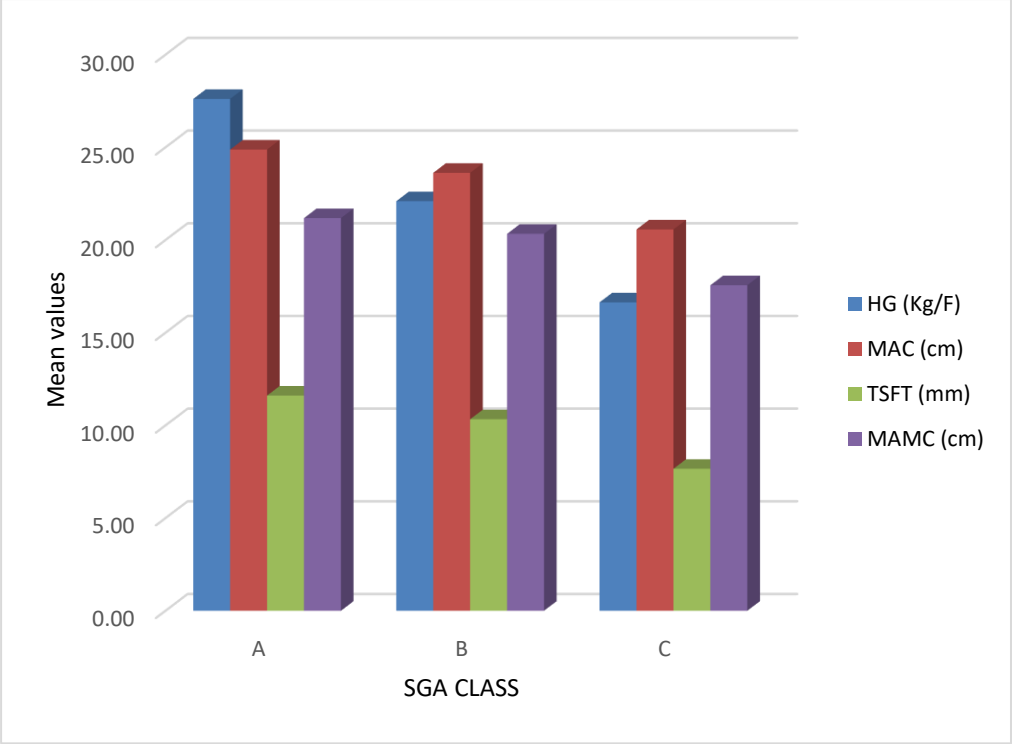

Figure 7: Association of mean values of Handgrip strength (HG), Mid Arm Circumference (MAC), Triceps skin Fold Thickness (TSFT) and Mid Arm Muscle Circumference (MAMC) of the study group with nutritional status

Table 12: Nutritional status of the study group according to Creatinine Height Index

CHI Class	No. of cases	Percentage
No Malnutrition	5	3.0
Mild Malnutrition	45	27.3
Moderate Malnutrition	90	54.5
Severe Malnutrition	25	15.2

Creatinine Height Index (CHI), calculated as amount of 24-hour urine creatinine, corrected for patient's height which accurately assesses the skeletal muscle mass, was used in our study as a parameter for nutritional assessment of cirrhotic patients. In our study, according to Creatinine Height Index value results, majority of the subjects had moderate malnutrition i.e. 54.5% (n=90). Mild malnutrition was found in 27.3% (n=45) patients while 15.2% (n=25) patients had poor malnutrition according to CHI index as shown in table 12 and figure 8.

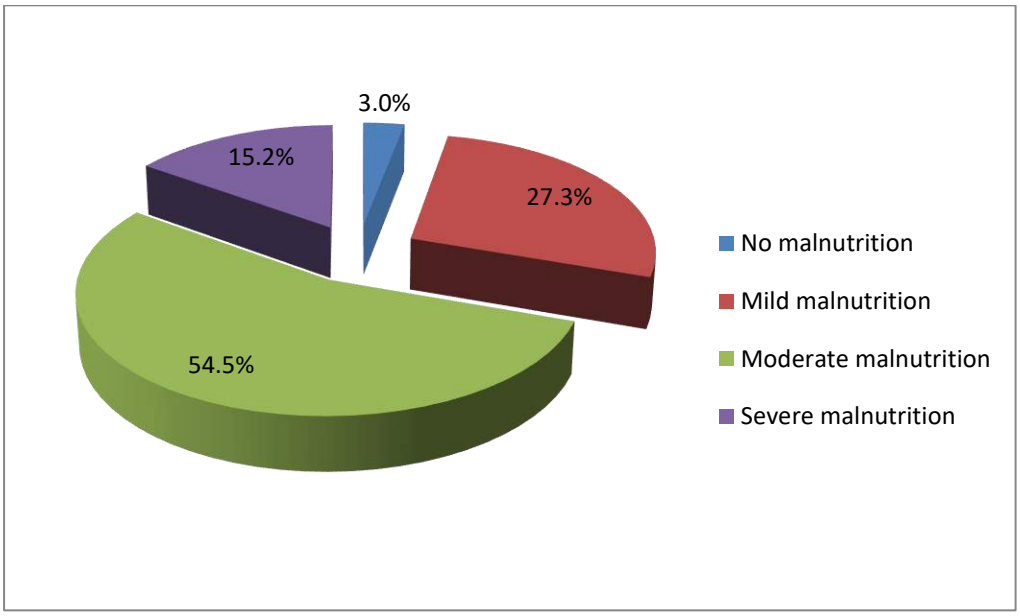

Figure 8: Nutritional status of the study group according to Creatinine Height Index

Table 13: Nutritional status of study group according to the Controlling Nutritional Status (CONUT) score

Controlling Nutritional Status (CONUT) Class	No. of cases	Percentage
No Malnutrition	1	0.6
Mild Malnutrition	43	26.1
Moderate Malnutrition	96	58.2
Severe Malnutrition	25	15.2

The Controlling Nutritional Status (CONUT) score is extensively used to evaluate nutritional status in various disease states. The CONUT score is calculated from the three laboratory parameters: serum albumin level, total cholesterol level and peripheral total lymphocyte count and depending on the score, nutritional status is classified into no, mild, moderate and severe malnutrition. On the basis of data collected, according to Controlling nutritional status (CONUT) Score, mild malnutrition was found in 26.1% (n=43) patients, moderate malnutrition in 58.2% (n=96) and severe malnutrition in 15.2% (n=25) patients. Table 13 and figure 9 represents the classification of nutritional status by using CONUT score.

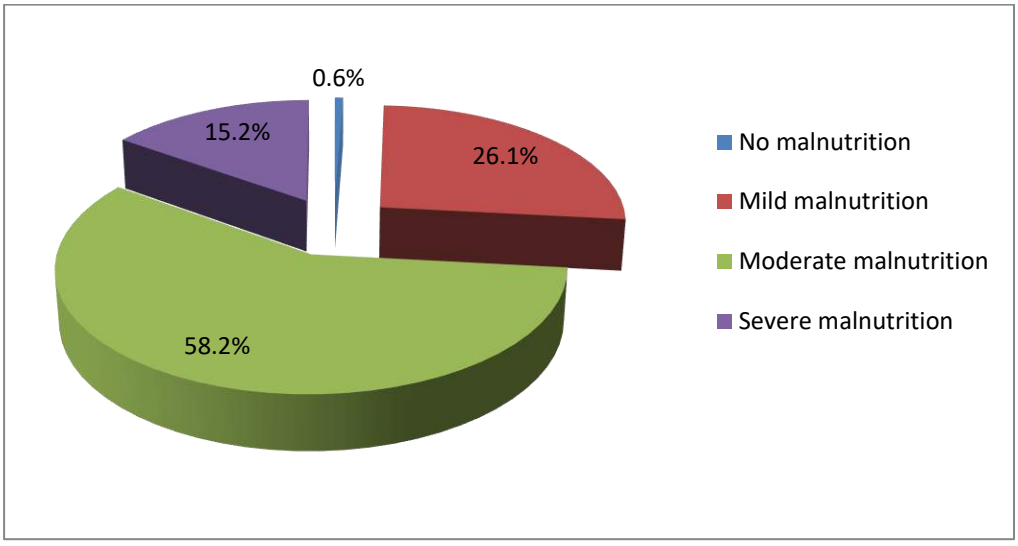

Figure 9: Nutritional status of study group according to the Controlling Nutritional Status (CONUT) score

Table14: Association of nutritional status of the study group according to SGA Class with severity of liver disease

	CTP Class						Total	p-value
SGA	**A**		**B**		**C**			
A	35	92.1%	22	30.1%	1	1.9%	58	0.0001*
B	3	7.9%	46	63.0%	36	66.7%	85	
C	0	0.0%	5	6.8%	17	31.5%	22	

***significant**

On comparing the malnourishment diagnosed by SGA score with severity of liver disease by CTP score, there was a significant difference, with increased incidence of malnutrition with increasing severity of liver disease. According to SGA score for diagnosing malnutrition, 7.9% of the patients in early stage cirrhosis like CTP A are malnourished, mild to moderate category. 63% patients of CTP B are mild to moderately malnourished and 6.8% are severely malnourished. 98.1% of patients in CTP C are malnourished, which is statistically significant. Severe malnourishment is high in CTP Class C (31.5%). Table 14 and figure 10 represent the relation of nutritional status of the study population with severity of liver disease.

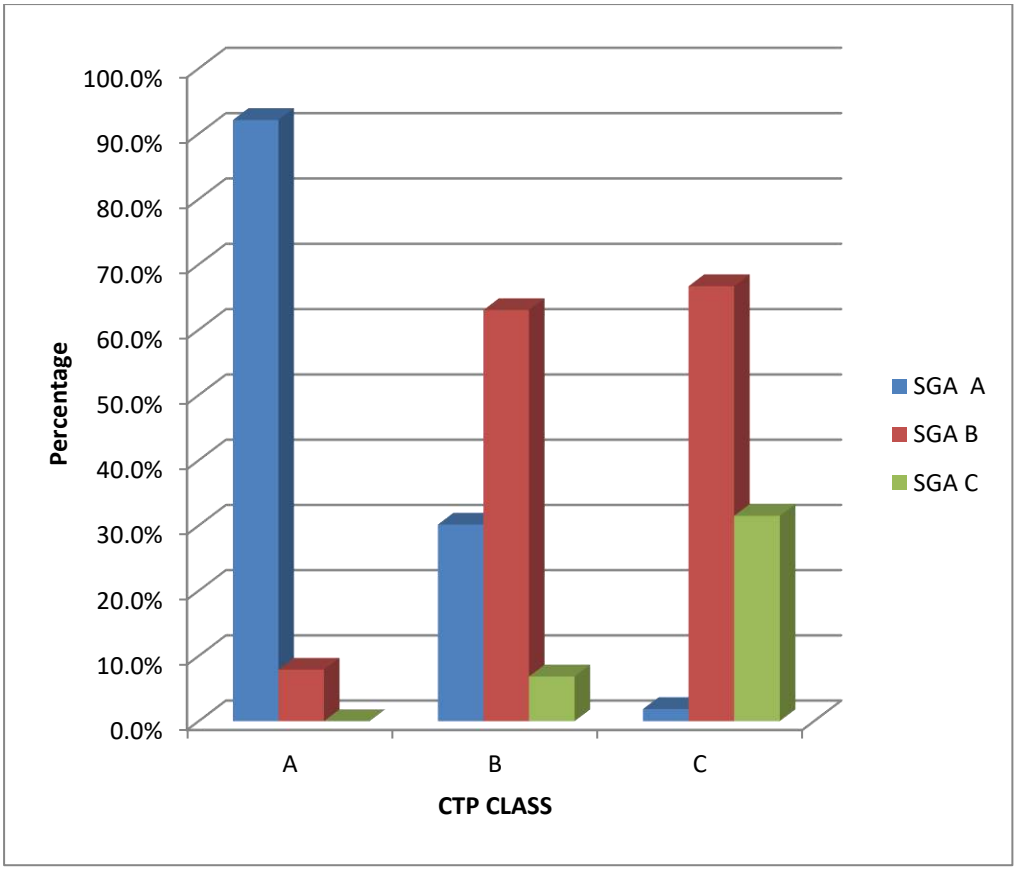

Figure 10: Association of nutritional status of the study group according to SGA Class with severity of liver disease

Table 15: Association of nutritional status of study group according to Creatinine Height Index with the severity of liver disease

CHI Class	CTP Class						Total	p-value
Degree of Malnutrition	**A**		**B**		**C**			
Normal	1	2.6%	3	4.1%	1	1.9%	5	0.0001*
Mild	18	47.4%	23	31.5%	4	7.4%	45	
Moderate	18	47.4%	37	50.7%	35	64.8 %	90	
Severe	1	2.6%	10	13.7%	14	25.9 %	25	

*significant

In our study, according to Creatinine Height Index, as shown in table 15 and figure 11, in CTP Class A, 18 patients had mild and moderate malnutrition each and only 1 patient had severe malnutrition. In CTP Class B, mild, moderate and severe malnutrition was seen in 23, 37 and 10 patients, respectively. In CTP Class C, mild malnutrition was seen in 4 patients while 35 patients had moderate malnutrition and 14 patients had severe malnutrition. Majority of the patients with severe malnutrition were of CTP Class C followed by CTP Class B (p value = 0.0001); indicating increased incidence of malnutrition with increasing severity of liver disease.

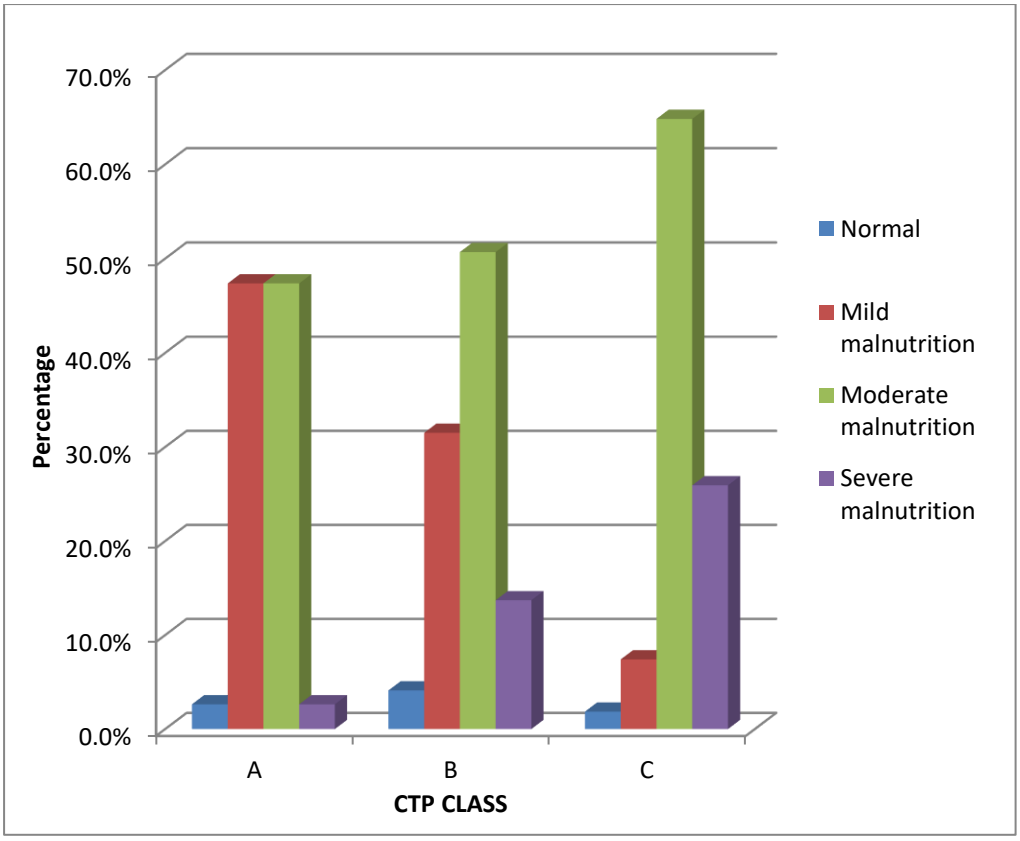

Figure 11: Association of nutritional status of study group according to Creatinine Height Index with the severity of liver disease

Table 16: Association of nutritional status of study group according to Controlling Nutritional Status (CONUT) with the severity of liver disease

CONUT Score	CTP Class						Total	p-value
Degree Of Malnutrition	A		B		C			
No	1	2.6%	0	0.0%	0	0.0%	1	0.0001*
Mild	28	73.7%	13	17.8%	2	3.7%	43	
Moderate	9	23.7%	52	71.2%	35	64.8%	96	
Severe	0	0.0%	8	11.0%	17	31.5%	25	

*significant

On comparison of the nutritional status of our patients by Controlling Nutritional Status (CONUT) score with the severity of liver disease, poor nutritional state was seen in advanced stages of cirrhosis (p value = 0.0001). In CTP Class A, about 3/4th of the patients had mild malnutrition i.e. 73.7% (n=28); 23.7% (n=9) patients had moderate malnutrition and no patient was associated with severe malnutrition. In CTP Class B, majority of the patients (71.2%) had moderate malnutrition and severe malnutrition was seen in 11% (n=8) patients only. In contrast, 64.8% (n=35) patients had moderate malnutrition and 31.5% (n=17) patients had severe malnutrition in CTP Class C while mild malnutrition was seen in only 3.7% (n=2) patients. More than half of patients with severe malnutrition belonged to CTP Class C as shown in table 16 and figure 12.

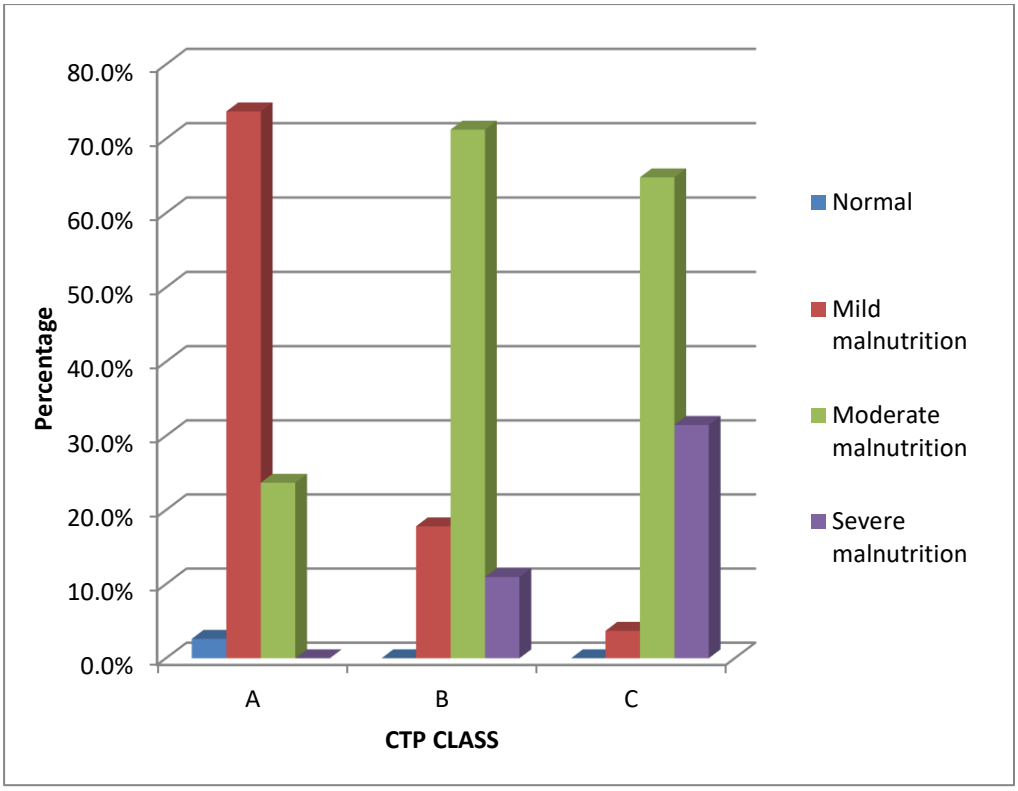

Figure 12: Association of nutritional status of study group according to Controlling Nutritional Status (CONUT) with the severity of liver disease

Table 17: Association of etiology of cirrhosis in the study group with the nutritional status

	SGA						Total	p-value
Etiology	**A**		**B**		**C**			
Alcohol	27	28.4%	53	55.8%	15	15.8%	95	0.096
NASH	31	39.7%	37	47.4%	10	12.8%	78	0.498
HBV	2	33.3%	3	50.0%	1	16.7%	6	0.970
HCV	3	21.4%	10	71.4%	1	7.1%	14	0.296
Autoimmune	1	100.0%	0	0.0%	0	0.0%	1	0.395
BCS	1	100.0%	0	0.0%	0	0.0%	1	0.395

In our study, alcohol is the most common etiology of cirrhosis associated with malnutrition. Among patients with alcoholic cirrhosis, 55.8% (n=53/95) were mild to moderately malnourished and 15.8% (n=15/95) patients were severely malnourished, though not statistically significant. 47.4% (n=37/78) patients with NASH were mild to moderately malnourished and 12.8% (n=10/78) were severely malnourished. Table 17 depicts the association of etiology of cirrhosis with nutritional status by SGA Class.

Table 18: Complications among the study group on follow-up

Complication	No. of cases	Percentage
Yes	96	58.2%
No	69	41.8%
Total	165	100.0%

Malnutrition is one of the contributing factors associated with poor outcomes in cirrhotic patients. It results in a higher complication rates like ascites, spontaneous bacterial infections (SBP), systemic infections, hepatic encephalopathy (HE), gastrointestinal bleed and acute kidney injury including hepatorenal syndrome (HRS). The patients in our study were evaluated at a follow up of 6 months for development of these complications. On follow up, liver related complications were seen in 58.2% (n=96) patients as shown in table 18 and figure 13.

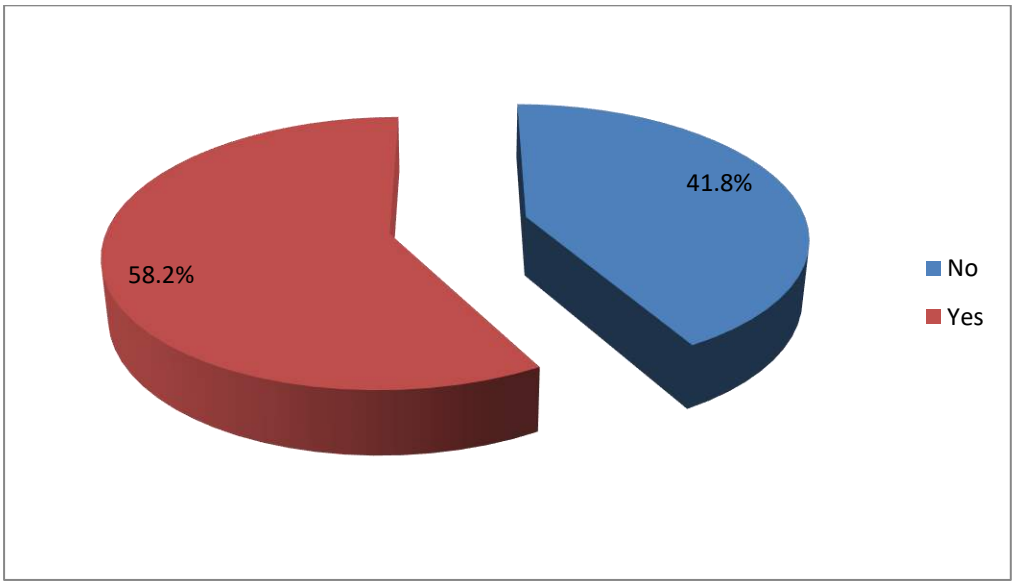

Figure 13: Complications among the study group on follow-up

Table 19: Complications among the study group on follow up

Complication	No. of cases	Percentage
Hepatic encephalopathy	67	40.6
Spontaneous bacterial peritonitis	32	19.4
Upper gastrointestinal bleeding	25	15.2
Hepatorenal syndrome	15	9.1
Hepatocellular carcinoma	1	0.6

In our study, most common liver related complication seen on follow up over a period of 6 months was hepatic encephalopathy (HE) followed by spontaneous bacterial peritonitis (SBP) and upper GI bleed. Some patients had more than one complications. Hepatic encephalopathy was seen in 40.6% (n=67) subjects followed by SBP, which was seen in 19.4% (n=32) patients and upper GI bleed in 15.2% (n=25) patients. Complications associated with cirrhosis seen in our study have been represented in table 19 and figure 14.

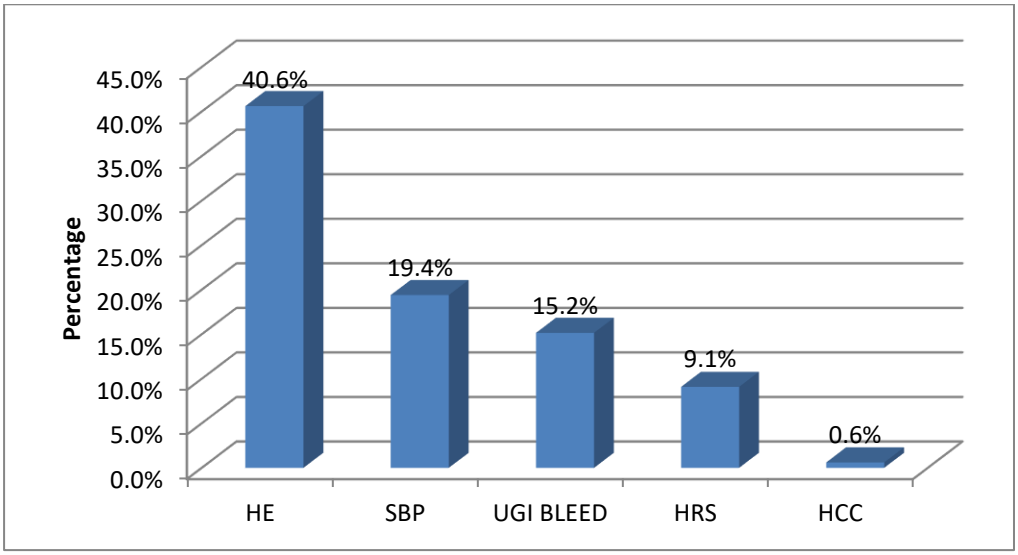

Figure 14. Complications among the study group on follow up

Table 20: Association of complications on follow up in the study group with the severity of the liver disease

	Complication					
CTP Class	**No**		**Yes**		**Total**	**p-value**
A	31	81.6%	7	18.4%	38	0.0001*
B	32	43.8%	41	56.2%	73	
C	6	11.1%	48	88.9%	54	

*significant

In our study, it was seen that 88.9% (n=48/54) patients in CTP Class C developed complications on follow up while 56.2% (n=41/73) patients in CTP Class B developed complications. Only 18.4% (n=7/31) patients in CTP Class A had liver related complications. Association of complications with severity of liver disease is shown in table 20 and figure 15. Thus, subjects with advanced liver disease are more prone to develop complications and have a poor outcome.

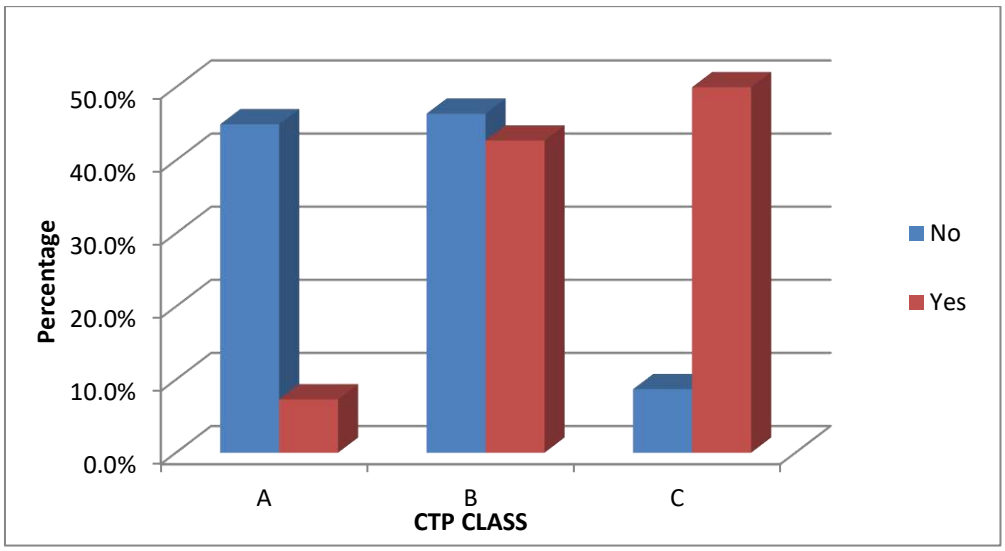

Figure 15: Association of complications on follow up in the study group with the severity of the liver disease

Table 21: Association of complications on follow up among the study group with etiology of liver disease

	Complication					
Etiology	**NO**		**YES**		**Total**	**p-value**
Alcohol	34	35.8%	61	64.2%	95	0.056
NASH	33	42.3%	45	57.7%	78	0.787
HCV	7	50.0%	7	50.0%	14	0.485
HBV	4	66.7%	2	33.3%	6	0.197
Autoimmune	1	100.0%	0	0.0%	1	0.231
BCS	1	100.0%	0	0.0%	1	0.231

Subjects with alcoholic cirrhosis were more likely to have one or the other liver related complications in future as compared to ones with non-alcoholic etiology. In our study, complications were seen in 64.2% (n=61/95) patients among alcoholic cirrhosis, 57.7% (n=45/78) patients of NASH related cirrhosis and 50% (n=7/14) patients of HCV related cirrhosis as represented in table 21 and figure 16.

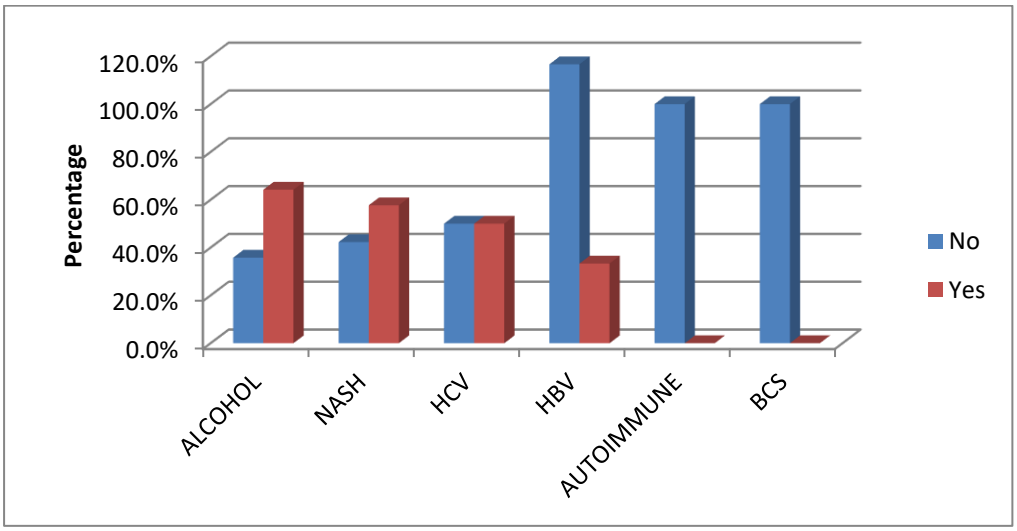

Figure 16: Association of complications on follow up among the study group with etiology of liver disease

Table 22: Association of complications on follow up in the study group with nutritional status according to Subjective Global Assessment (SGA)

	Complication					
SGA	**No**		**Yes**		**Total**	**p-value**
A	47	81.0%	11	19.0%	58	0.0001*
B	21	24.7%	64	75.3%	85	
C	1	4.5%	21	95.5%	22	

*significant

The occurrence of liver related complications on follow up was higher in patients with poor nutritional status in comparison to patients with mild to moderate malnourishment. In our study, 95.5% (n=21/22) patients of SGA Class C indicating poor nutritional status had one or the other complication on follow up. 75.3% (n=64/85) of SGA Class B had complications on follow up while only 19% well-nourished subjects had complications. There was a significant increase in the prevalence of complications including SBP and hepatic encephalopathy in malnourished cirrhotics (p value = 0.0001) compared to well-nourished patients as shown in table 22 and figure 17.

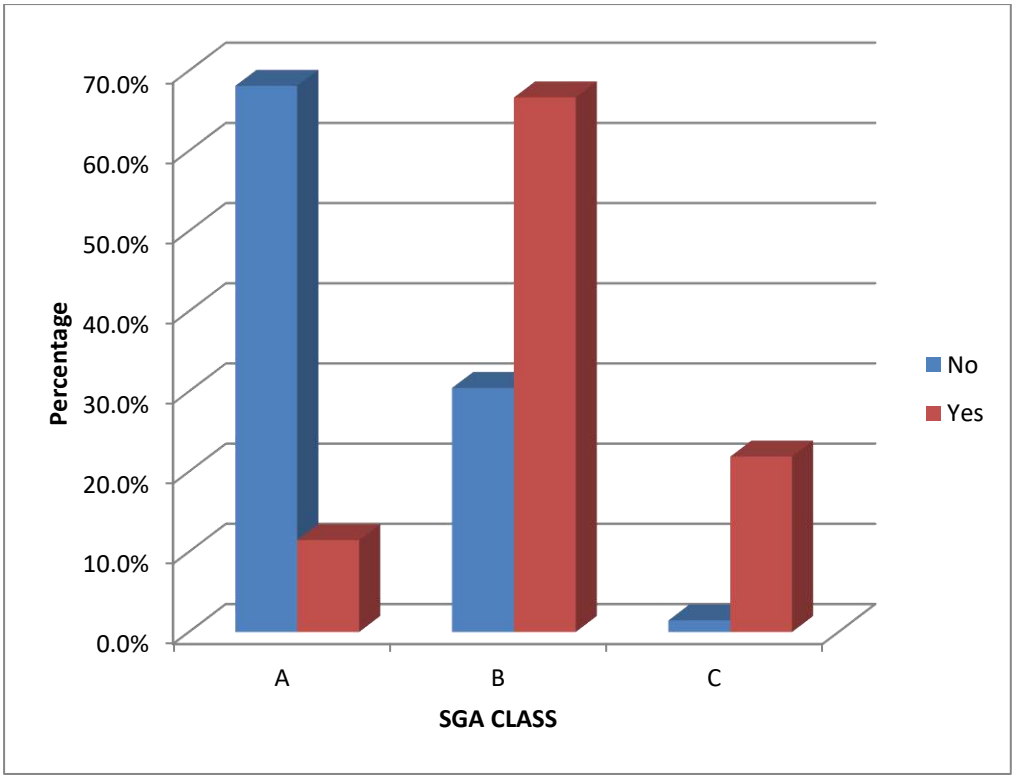

Figure 17: Association of complications on follow up in the study group with nutritional status according to Subjective Global Assessment (SGA)

Table 23: Association of complications on follow up in the study group with Body Mass Index (BMI)

		Complication				Total	p-value
		No		Yes			
BMI GROUP (Kg/m^2)	< 18.5	2	12.5%	14	87.5%	16	0.008*
	18.5-24.9	28	35.9%	50	64.1%	78	
	25-29.9	29	54.7%	24	45.3%	53	
	> 30	10	55.6%	8	44.4%	18	

*significant

In our study, out of 16 patients who were having BMI < 18.5 Kg/m^2, 87.5% (n=14) patients developed complications over a period of 6 months. Among those with BMI within normal range, 64.1% (n=50/78) developed one or the other liver related complication on follow up as shown in table 23.

Table 24: Association of complications on follow up in the study group with nutritional status according to Creatinine Height Index

	Complication					
CHI Class	No		Yes		Total	p-value
Normal	3	60.0%	2	40.0%	5	0.0001*
Mild Malnutrition	28	62.2%	17	37.8%	45	
Moderate Malnutrition	34	37.8%	56	62.2%	90	
Severe Malnutrition	4	16.0%	21	84.0%	25	

*significant

Similar to SGA Scoring, 84% (n=21/25) patients with severe malnutrition according to Creatinine Height Index (CHI) developed liver related complications on follow up; while 62.2% (n=56/90) patients with moderate malnutrition and 37.8% (n=17/45) patients with mild malnutrition developed complications as shown in table 24 and figure 18. Thus, the prevalence of complications on follow up was higher in severely malnourished patients in comparison to patients with mild to moderate malnourishment (p value = 0.0001).

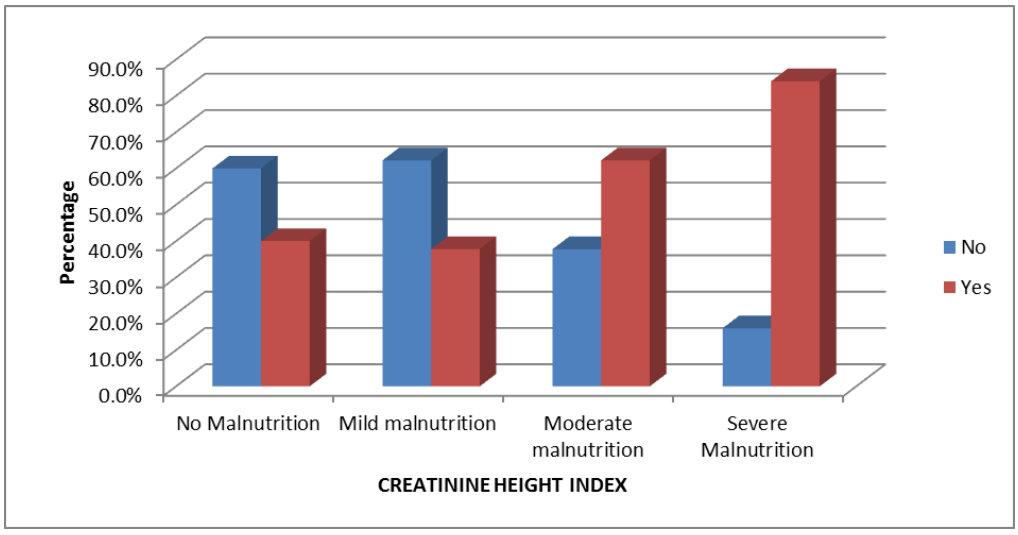

Figure 18: Association of complications on follow up in the study group with nutritional status according to Creatinine Height Index

Table 25. Association of complications on follow up in the study group with nutritional status according to Controlling Nutritional Status (CONUT)

CONUT score	Complications				Total	p-value
	No		Yes			
Normal	1	100.0%	0	0.0%	1	0.0001*
Mild Malnutrition	33	76.7%	10	23.3%	43	
Moderate Malnutrition	31	32.3%	65	67.7%	96	
Severe Malnutrition	4	16.0%	21	84.0%	25	

*significant

Nutritional status among study group was assessed according to the Controlling Nutritional Status (CONUT) score and liver related complications on follow up were analysed. 84% (n=21/25) patients with severe malnutrition developed complications while 67.7% (n=65/96) patients with moderate malnutrition and 23.3% (n=10/43) patients with mild malnutrition had complications as shown in table 25 and figure 19. The prevalence of complications on follow up was higher in severely malnourished patients in comparison to patients with mild to moderate malnourishment (p value = 0.0001), as seen in other nutritional assessment scores as well.

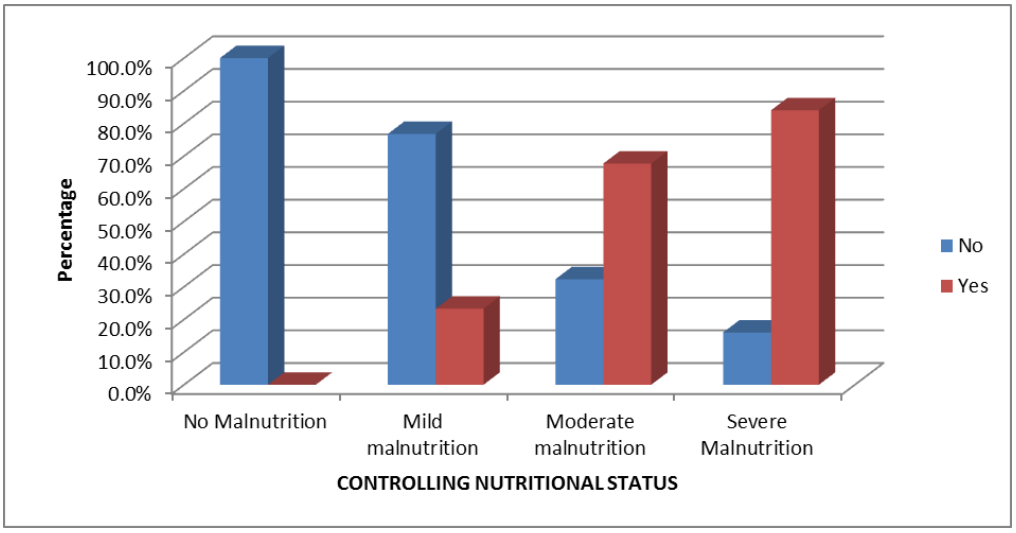

Figure 19: Association of complications on follow up in the study group with nutritional status according to Controlling Nutritional Status (CONUT)

Table 26: Comparison of various nutritional assessment tools in prediction of liver related complications

	p-value	Odd ratio	95% C.I. for Odd ratio	
			Lower	Upper
Mid Arm Circumference	0.892	0.939	0.375	2.350
Triceps Skinfold Thickness	0.138	1.484	0.880	2.502
Mid Arm Muscle Circumference	0.959	0.977	0.403	2.369
Handgrip strength	0.046*	0.895	0.802	0.998
Body Mass Index				
Undernutrition (reference)	0.374			
Normal BMI	0.906	0.877	0.100	7.691
Overweight	0.830	0.780	0.081	7.484
Obese	0.273	0.261	0.024	2.882
Creatinine Height Index				
No malnutrition (reference)	0.810			
Mild Malnutrition	0.987	1.018	0.114	9.111
Moderate Malnutrition	0.750	0.708	0.085	5.910
Severe Malnutrition	0.515	0.441	0.038	5.176

Controlling nutritional Status				
Mild Malnutrition (reference)	0.141			
Moderate Malnutrition	0.048*	3.014	1.011	8.987
Severe malnutrition	0.218	2.824	0.542	14.718
SGA				
SGA Class A (reference)	0.001*			
SGA Class B	0.001*	12.191	3.228	46.041
SGA Class C	0.003*	93.636	4.516	1941.440

*significant

In our study, nutritional assessment among patients with cirrhosis was done using different parameters and their association with occurrence of liver related complications was analysed using multiple logistic regression. When all parameters were compared, nutritional assessment by Subjective Global Assessment (SGA) method and its analysis was found to be better predictor for development of complications, which was statistically significant (p value = 0.001). Severe malnutrition as classified by SGA Class C had most significant association with development of liver related complications with an odd's ratio of 93.6 followed by mild to moderate malnutrition indicated by SGA Class B with odd's ratio of 12.19 as shown in table 26. Nutritional assessment using Controlling Nutritional Status score and Handgrip strength were also found to have a statistically significant association in prediction of cirrhosis related complications on follow up.

DISCUSSION

Assessment and treatment of malnutrition is an essential component of management in cirrhosis. Hospitalized cirrhotic patients are more prone to infections and poor outcome with long periods of inadequate or no nutrition due to various reasons. Poor attention toward patient's nutritional needs has the potential to further worsen malnutrition, encephalopathy, and overall prognosis. Hence, a key component of management of cirrhosis should focus on adequate nutritional support.

In our study, 165 patients were enrolled. Among them, 84.4% patients were males. The nutritional status among cirrhotic patients in our study was assessed by using Subjective Global Assessment (SGA), anthropometric data, Handgrip strength (HG), Creatinine height index (CHI) and Controlling Nutritional Status (CONUT) score. These methods were chosen because of easy availability, low cost and fast application and, and they can be incorporated into the routine nutritional assessment of the cirrhotic patients in developing countries like India.

The most common etiology of cirrhosis in the study group was alcohol followed by NASH. Chronic hepatitis B and hepatitis C were found in few patients. In a study conducted by Maharshi et al[85] at Delhi among 330 patients, most common etiology of cirrhosis was alcohol, seen in 53% patients but in contrast, hepatitis B virus and hepatitis C virus related cirrhosis were more as compared to our study. In contrast to our study, Bakshi et al[84] at Delhi reported that etiologically, 27.8 and 22.2% of the patients were suffering from liver disease because of HCV related infections and alcohol related cirrhosis, respectively. Similarly, a study conducted by Sharma et al[93] in North India showed that out of 178 patients diagnosed with cirrhosis, the most common cause of the disease was alcohol (62.9 %). Hepatitis B was the second cause of cirrhosis (10.1%) followed by NASH and autoimmune etiology. According to Zhai et al[94], Nonalcoholic steatohepatitis (NASH) is rapidly becoming the most common cause of chronic liver diseases worldwide. In addition, with the growth of obesity, population and aging, NASH might

replace alcohol and viral hepatitis as the most important cause of liver cirrhosis in the near future.

Ascites was seen in 63.7% patients in our study with 10.9% patients having tense ascites. Similarly, in the study by Maharshi et al[85], ascites was present in 68.8% patients at the time of nutritional assessment. In addition, ascites was found in 80.4% of the study population by Vishnu Raju et al[65]. Huelin et al[95] considered ascites as the most common complication in cirrhosis that may lead to several life threatening complications and it is seen to develop in 60% of the patients with decompensated cirrhosis and linked with poor prognosis and quality of life. Reyes et al[96] in their study concluded that malnourished patients have higher frequency of development of ascites (67.2%). Alcohol and ascites both reduce the food intake. The fact that majority of the study group were alcoholics and majority of them had ascites, malnourishment was found to be common among cirrhotics.

Severity of liver disease was calculated in our study using Child Turcotte Pugh (CTP) score and majority of the patients were in CTP Class B, i.e., 44.2%. 32.7% patients of the study group were in CTP Class C followed by CTP Class A including 23% patients. Similarly, Reyes et al[96], conducted study on 103 cirrhotic patients and it was seen that maximum respondents were having CTP B (57.3%), followed by CTP Class C (23.3%) and then CTP Class A (19.4%).

In the present study, as per Subjective Global Assessment (SGA), malnutrition was seen in 64.8% of patients, which was in concordance with other studies. 13.3% patients of the study group were severely malnourished according to Subjective Global Assessment. Our results were in concordance with the study by Patricia M.Vieira et al.[81], in which by SGA, 48 (61.5%) patients were diagnosed as malnourished, 41% had moderate malnutrition and 20.5 % had severe malnutrition. A study by Amany M. Abdelhafezon et al[97] on 161 patients revealed that nearly half of study group (50.9%) had moderate malnutrition (SGA B) and 16.8% had severe malnutrition (SGA C). The result of our study were similar to

Yao et al.[98], who carried out a study on 120 patients with HBV or HCV-related cirrhosis and found that 48.3% were moderately malnourished (SGA B), and 11.7% severely malnourished (SGA C). Also, Ferreira et al.[99] performed a study on patients older than 20 years who were on the waiting list for liver transplantation in a liver transplantation outpatient clinic in Brazil and found that malnutrition was present in 74.7% of the patients; 53.8% were moderately and 20.9% were severely malnourished. In the study by Bakshi et al[84], nutrition status assessment by SGA showed only 15.2% of the patients as normal whereas 75.8% of the patients were moderately malnourished and 9.1% as severely malnourished.

The diagnosis of malnutrition by SGA involves assessment by various parameters such as reduction of body weight; gastrointestinal alterations, such as, diarrhoea, anorexia, nausea and vomiting; a reduction in the consistency and in the quantity of food intake; a reduction in functional capacity and with the increased expenditure of energy associated with cirrhosis. The depletion of the adipose tissue, of muscular mass and fluid retention in form of ascites and swelling of the ankles was verified by the physical examination by SGA. Although these alterations might be associated with the diagnosis of malnutrition, they do arise from cirrhosis. The reduction of the functional capacity of these patients could be due to the presence of ascites and/or from the deficiency of micronutrients arising from frequent and chronic use of diuretics. The presence of swelling could result from the reduction of albumin synthesis associated with chronic hepatic insufficiency.

Anthropometric parameters like Mid arm circumference (MAC), Triceps skin-fold thickness (TSFT) and Mid arm muscle Circumference (MAMC) are simple, useful and recommended methods to assess muscle and fat mass in cirrhosis patients but only physical examination by anthropometric measurements might not be reliable as a nutritional assessment tool. A combination of nutritional assessment tools is recommended for nutritional evaluation of these patients[100].

Malnutrition is considered an independent predictor of survival and Alberino et al[6] have demonstrated that addition of the Mid arm muscle circumference and the Triceps skin fold improved the prognostic accuracy of the Child Turcotte Pugh (CTP) classification. Therefore, they had suggested that nutritional status assessment could be used in conjunction with the Child Turcotte Pugh (CTP) classification in the evaluation of the prognosis of cirrhotic patients. The present study demonstrated significantly higher ($p = 0.01$) prevalence of malnutrition in higher CTP class which is comparable to various studies.

In our study, the anthropometric values significantly showed difference in the malnourished group (SGA B and C).The present study found that the mean BMI was 24.34 Kg/m^2, mean MAC was 23.6 cm, mean TSFT was 10.42 mm and mean MAMC was 20.26 cm. Regarding body mass index (BMI), the present study showed that only 9.7% patients had BMI below 18.5 Kg/m^2, majority of them were in SGA Class C. This result agreed with Qinggang et al.[101], who reported that 11.6% of study population was underweight and Roongpsuthipong et al[27], in which 11.7% patients had low BMI. Using body mass index (BMI), in the study by Patricia et al.[81], malnutrition was diagnosed in 13 (16.7%) patients, of which nine (11.5%) patients had mild malnutrition, two (2.6%) had moderate malnutrition and two (2.6%) had severe malnutrition. In the study by Nunes et al[86], 10 (8%) patients with a low BMI were considered malnourished and 92% patients displayed normal or high BMI.

The normal range for anthropometry values has not been defined in the healthy population in India. Regarding the relationship between chronic hepatic disease severity and malnutrition, values by different anthropometric tools for Child Class C were lower than that for Child A and B in the current study. The anthropometry values of MAC, TSFT and MAMC were significantly low in malnourished group, SGA B and C. Patricia et al [81] and Gunsar et al[102] reported similar MAMC and TSFT values in malnourished patients. The determination of % MAC and % MAMC demonstrated, respectively, a greater number of malnourished patients in Child Class C and B than in Child Class A indicating that the

frequency of diagnosis of malnutrition increased according to the severity of cirrhosis. Patients who were classified as malnourished according to SGA had a lower mean Hand grip strength (HG) than those who were well-nourished. These results were expected as lower hand grip strength may reflect a decrease in muscle function which occurs in malnutrition. In contrast, Tai et al[66] used Hand Grip Dynamometry in population of 36 patients and did not find any significant difference in Hand Grip values between well-nourished and malnourished patients. These cost effective bed side assessment parameters like Mid Arm Muscle circumference, Triceps Skin fold Thickness and Hand Grip strength can detect undernourished group of cirrhotic patients early in the course of disease to subject them to medical nutritional therapy.

There was a statistically significant difference between the three CTP classes as regards MAC, TSTF, MAMC and HG strength. This result is consistent with a prospective study by Bakshi et al[8] on patients with compensated and decompensated liver disease in an outpatient unit which revealed that, except for BMI, Child Class C patients had significantly lower anthropometric measurements compared to Child Class A & B cases. Also, Ferreira et al.[99] observed that the loss of muscle mass assessed by MAC was associated with severity of disease assessed by CTP criteria. However, in contrast to our study Fernandes et al.[70] demonstrated that hand grip strength test didn't show statistically significant relation with the Child-Pugh classes.

Association between severity of liver disease using Child Turcotte Pugh (CTP) classification and the nutritional status of patients in these CTP Classes was analysed by different nutritional assessment tools. Generally, malnutrition prevalence increased with the more advanced stages of disease. In the present study, there was highly significant relationship between malnutrition assessed by Subjective Global Assessment (SGA) and severity of liver disease assessed by Child Pugh score. In our study, the CTP scores gradually increased from the well-nourished group to severely malnourished group, correlating well with the SGA. These findings agree with Tai et al.[66], who found a higher

proportion of poor nutritional status (SGA C) in Child Class C patients compared to Child Class B patients. A study by Saleh et al.[63] found a tendency towards a higher proportion of poor nutritional status, assessed by SGA, in patients with Child Class B & C compared to Child Class A. Daphnee et al[82] found malnutrition in 46 patients out of 93 by subjective global assessment and it significantly increased with increasing MELD score, Child Turcotte Pugh (CTP) score and decreasing handgrip strength.

In the study by Maharshi et al.[85], 59.5% patients were malnourished; 33.3% among those in Child Class A, 51.9% in B, and 78.6% among Child Class C. In contrast to study by Carvalho et al[103], which had 21% patients of CTP Class A having malnourishment, our study reported only 7.9% patients with mild to moderate malnourishment in early stages of cirrhosis. Significantly higher malnourishment was seen in CTP Class C than A and B in the study by Bakshi et al[84], in concordance with our study. Cirrhosis, even if not decompensated can be a cause for nutritional deficit through mechanisms of hyper metabolism, bile acid deficiency for micellar formation and fat absorption, muscle proteolysis for sustaining glycogen synthesis and others. Hence the nutritional parameters like Subjective Global Assessment score is invaluable in detecting the undernourished even early in the course of the disease, and it is probably one of the most cost effective bed side tool that is available so far.

In our study, according to Creatinine Height Index (CHI), mild malnutrition was found in 27.3% patients, moderate malnutrition in 54.5% and severe malnutrition in 15.2% patients. Majority of the patients with severe malnutrition were of CTP Class C followed by CTP Class B; indicating increased incidence of malnutrition with increasing severity of liver disease. Similar results were seen in study by Roongpisuthipong et al[27] in which mean values for creatinine-height index, showed significant decrease towards Child class C. In the study by Hassan et al[61], based on CHI, protein calorie malnutrition was detected in 94.1%; 47.5 and 38.6% of patients had mild and moderate protein depletion,

respectively and severe protein depletion was found in 7.9%. In the study by Medhat et al[104], according to CHI, malnutrition was present in 89.2% of patients: 11.8% were mildly malnourished, 40.8% were moderately malnourished and 36.6% were severely malnourished. All these studies reported a high prevalence of malnutrition among cirrhotics. Also, Maharshi et al.[85] demonstrated that the CHI showed a significant correlation with liver disease severity as assessed by Child Turcotte Pugh score.

Our study showed that 99.3% of our population was malnourished according to Controlling Nutritional Status (CONUT), where mild, moderate and severe malnutrition was found in 26.1%, 58.2% and 15.2% patients, respectively. 31.5% patients with CTP Class C were severely malnourished and 64.8% were moderately malnourished while 11% patients of CTP Class B were severely malnourished and 71.2% moderately malnourished. Hiroki Nishikawa et al[80] reported the prevalence malnourishment to be 78.4% among HCV related cirrhotic patients using this score. Our results were similar to the study by Taniguchi et al[78] among 165 patients and found that values of CONUT were significantly associated with severity of disease. A study by Cholongitas et al[77] considered the value of CONUT closely associated with severity of chronic liver disease, and labelled it as one of the most predictive factors for prognosis in cirrhotic patients.

Alcoholic patients are more prone for protein calorie malnutrition (PCM) according to literature. On relating the etiology of cirrhosis to the nutritional state of the patients, a greater number of patients with malnutrition were seen among alcoholic etiology than those with non-alcoholic etiology. 71.6% patients of alcoholic cirrhosis were malnourished. Similarly, Patricia et al.[81], reported a greater number of malnourished and severely malnourished patients among those of the group with alcoholic etiology of cirrhosis (34/44 and 13/44), than among those with non-alcoholic etiology (14/34 and 3/34), respectively. Similar increased PCM in alcoholics was reported by Carvalho et al[103].

In our study, 58.2% patients developed liver related complications during follow up period of 6 months. Most common complication was found to be hepatic encephalopathy (41.2%) followed by spontaneous bacterial peritonitis (SBP) and upper gastrointestinal bleed. Those with alcoholic cirrhosis developed complications more than non-alcoholic etiology, although it was not statistically significant. The prevalence of these complications was more in malnourished patients than well nourished, those severely malnourished being more affected. In the present study, 95.5% patients of SGA Class C indicating severe malnutrition and 75.3% patients of SGA Class B developed atleast one of the complications on follow up. 84% severely malnourished patients according to CHI score and CONUT score were found to develop complications in our study. This was in concordance with the study by Maharshi et al[85], in which complications requiring hospitalisation were more in malnourished compared to well nourished; 158 patients developed complications of which 137 were malnourished during 12 months of follow up. Similarly, Vishnu Raju et al[65] showed that the prevalence of hepatic encephalopathy (HE) and SBP were higher in severely malnourished patients in comparison to patients with mild to moderate malnourishment.

Among those patients who developed complications on follow up, 90.7% patients were in CTP Class C and 56.2% patients in CTP Class B.18.4% patients of CTP Class A also ended up with one or the other liver related complication. The results are relevant because patients with malnutrition, even with Child Class A, have a greater risk of developing life threatening complications as compared to healthy adults. These results were similar to study by Maharshi et al[85], in which among patients who developed complications, majority belonged to CTP Class C approximating 78.5%, with 20.3% in CTP class B and 1.2% in CTP Class A. The prevalence of Hepatic Encephalopathy (HE) being high with malnourishment in our study was in agreement with the study by Kalaitzakis et al[105], where they concluded poor nutritional status as the contributing mechanism for HE. Study by Sam and Nguyen[106] showed

the association of malnutrition with longer hospitalization, higher in-hospital mortality, and a higher rate of readmissions.

Decompensated cirrhosis patients subjected to repeated paracentesis and diuresis and those with SBP lose the macronutrients from their ascitic fluid and invariably progress towards the course of nutrient deficiency. Hence it is inevitable that infections like SBP are going to be a major problem in those who are malnourished. Long term antibiotic prophylaxis for SBP and medical nutrition therapy is a part of standard of care in cirrhosis. The therapeutic management may be considered incomplete in patients with compensated and decompensated cirrhosis without achieving adequate nutritional status.

Our study compared various nutritional assessment parameters with the development of liver related complications over a period of 6 months and found significantly higher prevalence of complications in patients who were malnourished especially those with severe malnutrition. When these parameters were analysed together, nutritional assessment by SGA was found to be the most significant predictor of development of complications, with SGA Class C having maximum odd's ratio among all the parameters. Among others, CONUT and Handgrip strength also correlated well with the development of complications of follow up, which was statistically significant. Most of the studies done before have analysed one or two assessment parameters at a time. Our study analysed occurrence of complications with malnourishment in cirrhotic patients by all parameters used for nutritional assessment and also compared their results to predict the most significant tool among them that may be helpful in predicting outcome and prognosis. Thus, Subjective Global Assessment better estimated the development of complications in malnourished cirrhotic patients than other parameters.

Our results showed significantly higher degree of malnutrition in advanced liver disease when nutritional status was assessed by Subjective Global Assessment (SGA), Creatinine height index (CHI), Controlling Nutritional status (CONUT) and anthropometry. The

nutritional status was poor in patients with alcoholic cirrhosis as compared to non-alcoholic etiology. Regarding the severity of hepatic insufficiency, more frequent diagnosis of malnutrition, particularly of severe malnutrition, was demonstrated among patients with severe hepatic insufficiency. Thus, with most of the employed methods it is possible to demonstrate that the prevalence of malnutrition and of severe malnutrition increases in accordance with the worsening of the hepatic function. Similar results have been demonstrated by other investigators. This data can be very important for the preventive and therapeutic nutritional management of patients who are in the initial stages of cirrhosis. In the early stages of cirrhosis, patients can present various degrees of malnutrition, but they are still able to develop an appropriate therapeutic response to nutritional deficiencies directed towards the recuperation and maintenance of a normal nutritional state. The recuperation of the nutritionally deficient state of patients with more advanced stages, who present a greater frequency of severe malnutrition, can be hampered by hepatic insufficiency, which could negatively define their prognoses.

To conclude, malnutrition is a frequent finding in patients with cirrhosis and influences short and long term prognosis in these patients. The findings from the present study thus, clearly show a negative impact of malnutrition on prognosis of the cirrhotic patients. Patients with poor nutritional status are more likely have more complications and poor outcomes as compared to their better nourished counterparts. Recognition and treatment of malnutrition caused by chronic liver disease is of utmost importance. Considering the high prevalence of malnutrition, it is important to identify and rectify various nutritional deficiencies in cirrhosis.

SUMMARY AND CONCLUSIONS

Malnutrition is highly prevalent among patients with cirrhosis, including the well compensated cirrhosis also. It increases in frequency with severity of disease and is associated with an increased morbidity and mortality. Therefore, all patients with cirrhosis should be screened for malnutrition, regardless of etiology or severity. The present study was conducted at Dayanand Medical College and hospital, Ludhiana among 165 inpatients and outpatients with cirrhosis of various etiologies. Nutritional status of these patients was evaluated using anthropometry, muscle strength assessment, biochemical parameters and subjective global assessment. The nutritional status of the patients was analysed with severity of liver disease and occurrence of liver related complications.

- Among 165 patients of the study group, 140 were males and 25 were female patients. The mean age among males and females was 49.76 ± 9.28 years and 57.0 ± 8.77 years, respectively.
- 40.6% patients of the study group belonged to the 4th decade. 32.1% and 17.6% patients belonged to 5th and 6th decade, respectively.
- Alcohol was found to be the most common etiology of cirrhosis in our study followed by NASH.
- On the basis of severity of liver disease, majority of the patients were in CTP Class B (44.2%) followed by CTP Class C (32.7%) and CTP Class A (23%).
- 9.7% patients were undernourished according to BMI while majority of the patients (47.3%) had normal BMI.
- Using Subjective Global Assessment (SGA), 64.8% patients were malnourished. 51.5% patients were mild to moderately malnourished (SGA B) while 13.3% had poor nutritional status (SGA Class C).
- Values were significantly low in malnourished patients compared to well-nourished among anthropometric tools such as Mid Arm

Circumference (MAC), Triceps Skinfold thickness (TSFT), Mid Arm Muscle Circumference (MAMC) and Handgrip Strength (HG) and correlated well with severity of liver disease.

- Mild, moderate and severe malnutrition among cirrhotic patients was seen in 27.3%, 54.5% and 15.2%, respectively, using the Creatinine Height index (CHI).
- Controlling Nutritional Status (CONUT) score showed mild, moderate and severe malnutrition in 26.1%, 58.2% and 15.2% patients with cirrhosis, respectively. There was a statistical significant increase in incidence of malnutrition with increasing severity of liver disease.
- Malnutrition was more common in patients with alcoholic etiology as compared to non-alcoholic etiology, though not statistically significant.
- On follow up, liver related complications were seen in 58.2% patients. Most commonly was hepatic encephalopathy (HE) followed by spontaneous bacterial peritonitis (SBP). Subjects with advanced liver disease more commonly developed complications, more with alcoholic etiology of cirrhosis.
- There was a statistically significant increase in the occurrence of complications in malnourished cirrhotic patients, especially severely malnourished compared to well-nourished ones using various nutritional assessment tools.
- On comparison among all nutritional assessment parameters, Subjective Global Assessment (SGA) and its analysis was found to be better predictor for development of complications. SGA Class C had most significant association with development of liver related complications with an odd’s ratio of 93.6 followed by SGA Class B with odd’s ratio of 12.19.

CONCLUSIONS

Malnutrition is high in patients with cirrhosis using different parameters of nutritional assessment in our study. Nutritional assessment parameters significantly correlated with the severity of liver disease. Nutritional status was poor in alcoholic cirrhotics compared to those with other etiologies of cirrhosis. Malnutrition in cirrhotics was found to be related to worse clinical outcomes and higher incidence of liver related complications as hepatic encephalopathy, spontaneous bacterial peritonitis, gastrointestinal bleed and hepato-renal syndrome. Subjective Global Assessment (SGA) estimated the occurrence of complications in cirrhotic patients with malnourishment better than other parameters. Thus, it is important to screen every patient with cirrhosis for presence of malnutrition and advocate appropriate nutritional therapy accordingly for better quality of life and prevention of complications.

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MASTERCHART KEY

S.No.

Name

Mrd no.

Age Group:	<30 years	0
	31-40 years	1
	41-50 years	2
	51-60 years	3
	>61 years	4

Sex:

Male Female

Address:

Urban Rural

Complaints:

Abdominal Distension	1
Pain Abdomen	2
Jaundice	3
Decresed Appetite	4
Weakness	5
Dyspnoea	6
Others	7

Past History:

None 0

CLD 1

DM 2

HTN 3

HBV 4

HCV 5

Hypothyrodism 6

Others 7

Alcohol:

Yes No

Smoking:

Yes No

IVDU:

Yes No

Etiology:

Yes 1

No 2

Alcohol / NASH/ HBV/ HCV/ Autoimmune/BCS/Idiopathic

CTP Class:

A 1

B 2

C 3

Ascitis:

No	1
Mild	2
Moderate	3
Gross	4

BMI:

<18.5 Kg/m^2	1
18.5-24.9	2
24.9-29.9	3
>30	4

UGIEndoscopy:

Normal	1
Mild PHG	2
Gr 1-2 Vx	3
Gr 3 Vx	4
Gastric Vx	5
Angioectsias	6
Ulcer Disease	7
Not Done	8

CHI SCORE:

>80 %	0
80-60%	1
60-40%	2

<40%	3

CONUT SCORE:

0-1	0
2-4	1
5-8	2
9-12	3

SGA:

A	1
B	2
C	3

FOLLOW UP:

Complication

No	1
Yes	2

NONE	1
SBP	2
HE	3
HRS	4
UGI BLEED	5
HCC	6

Serial no.	MRD	Age	Sex	Address	C/C	Past H/O	Alcohol	Smoking	IVDU	Etiology	ALCOHOL	NASH	HBV	HCV	AUTOIMMUNE	BCS	HB	TLC	T. Lymphocyte	Platelet	Total Bil.	Creat	T. protein	Albumin
1	1031947	49	Male	Urban	1	1	Yes	No	No	1	1	2	2	2	2	2	7.7	5.5	1925	217	1.86	1.29	7.8	2.93
2	1065279	39	Male	Urban	1,3	1	Yes	No	No	1	1	2	2	2	2	2	7.9	4.4	1320	90	5.6	0.75	6.6	2.65
3	1069971	42	Male	Urban	5	1	Yes	No	No	1	1	2	2	2	2	2	10.05	5.4	2322	102	1.56	0.69	5.8	3.11
4	1069989	48	Male	Rural	3,4	1	Yes	No	No	1	1	2	2	2	2	2	13.6	8.1	2187	44	4.5	1.42	5.1	2.76
5	1082402	45	Female	Rural	2	1,6	No	No	No	2	2	1	2	2	2	2	7.4	2.1	735	54	1.06	0.5	7.2	2.89
6	49819	50	Male	Urban	2,5	1	No	No	No	2	2	1	2	2	2	2	9.2	5.3	2273	74	2.3	0.67	5.9	2.33
7	230171	56	Male	Rural	4,5	1,2	No	No	No	2	2	1	2	2	2	2	11.6	5.3	850	170	3.5	0.85	7.3	4.2
8	1026005	52	Male	Rural	2	1,2	No	No	No	2	2	1	2	2	2	2	10.6	7.2	1476	106	4.3	1.4	9.5	2.64
9	1062711	64	Female	Urban	1	1,2	No	No	No	2	2	1	2	2	2	2	11	5.2	1554	103	2.1	0.91	5.9	2.9
10	1074045	60	Female	Rural	1,2	1,2	No	No	No	2	2	1	2	2	2	2	13.1	7	1267	118	4.5	1.1	7.4	4.5
11	1071136	53	Female	Rural	1,3,4	0	No	No	No	2	2	1	2	2	2	2	12.7	8.9	1103	83	2.6	1.07	6.2	3.09
12	988101	62	Male	Rural	1,4	2	Yes	No	No	1,2	1	1	2	2	2	2	7.6	3.4	443	90	2.83	0.93	7	2.43
13	798867	61	Male	Urban	4,5	1,6	No	No	No	2	2	1	2	2	2	2	12.1	10.9	2027	70	3.3	1.3	6.6	1.95
14	1002785	36	Male	Rural	3,4	0	Yes	No	No	1	1	2	2	2	2	2	8.4	10.6	1473	68	5	0.55	6.8	3.03
15	855600	61	Female	Urban	1	1	No	No	No	2	2	1	2	2	2	2	7	5.5	2216	253	0.94	0.74	5.3	2.3
16	1008514	56	Male	Rural	7	1,2,3	Yes	Yes	No	1,2	1	1	2	2	2	2	6.6	13.7	2543	80	3.2	1.23	4.9	2.11
17	1087794	52	Male	Rural	1,2	2	No	No	No	2	2	1	2	2	2	2	7.3	4.5	900	110	1.19	0.54	6.8	3.49
18	978911	45	Male	Rural	1,3,5	1,2	Yes	Yes	No	1,2	1	1	2	2	2	2	7.7	3.5	696	58	4.2	0.7	6.1	2.8
19	968902	43	Male	Urban	1,3	0	Yes	Yes	No	1	1	2	2	2	2	2	11.7	15	2340	130	2.11	1.3	6	4.37
20	926935	36	Male	Urban	2	1	Yes	Yes	No	1	1	2	2	2	2	2	10.5	7	1001	106	4.7	0.84	7.4	3.54
21	1006414	50	Male	Urban	1,2	1	Yes	No	No	1	1	2	2	2	2	2	7	9.6	1392	140	4.1	0.92	6.1	2.9
22	1112064	51	Male	Urban	4,7	0	Yes	Yes	No	1	1	2	2	2	2	2	7	5.5	1812	70	1.87	1.35	6.2	2.52
23	545606	57	Female	Rural	5	0	No	No	No	2	2	1	2	2	2	2	10.9	8.3	1718	102	5.6	0.68	6.1	2.64
24	1048979	18	Male	Rural	1	1	No	No	No	6	2	2	2	2	2	1	10.1	2	740	16	1.24	0.84	7.1	4.6
25	1046603	54	Male	Rural	4	1,5	Yes	Yes	No	1,4	1	2	2	1	2	2	8.7	11	1837	456	1.2	0.58	6.2	3.09
26	903490	61	Male	Urban	5	1	Yes	No	No	1	1	2	2	2	2	2	10.5	5.2	1632	77	0.7	1.08	6.4	2.5
27	406692	50	Male	Urban	2,4	1	Yes	No	No	1	1	2	2	2	2	2	9.2	4.2	806	66	1.69	0.97	6.6	2.9
28	62708	65	Female	Rural	4,5	1,2,5	No	No	No	2,4	2	1	2	1	2	2	8.9	7.2	1130	76	2.2	1.3	7.7	3.2
29	1023788	58	Female	Rural	3	1,2	No	No	No	2	2	1	2	2	2	2	11.7	6.1	1451	100	5.8	1.17	6	2.6
30	1024765	62	Male	Urban	1,3,4	1	Yes	No	No	1	1	2	2	2	2	2	8.4	8.2	1459	118	4.2	1.31	7.1	2.59
31	1008506	65	Male	Rural	3,4	0	Yes	No	No	1,4	1	2	2	1	2	2	9.6	9	2122	77	14	1.42	5.2	2.81
32	1029897	58	Male	Rural	1,6	1	Yes	No	No	1	1	2	2	2	2	2	8.9	4.2	882	44	2.18	0.95	5.5	3.16
33	867961	46	Male	Rural	3,5	1	Yes	No	No	1,3	1	2	1	2	2	2	8.2	2.1	483	108	6.1	1.08	6.8	3.22
34	368820	55	Male	Urban	5	1,2	No	No	No	2	2	1	2	2	2	2	7.2	6.9	1725	117	3.69	1.12	8.4	2.39
35	934900	51	Male	Urban	2,3	1,2	No	No	No	2	2	1	2	2	2	2	8.2	4	1000	150	4.9	0.33	7.3	2.28
36	49319	51	Male	Urban	7	1	No	No	No	2	2	1	2	2	2	2	11.8	6.8	1786	156	1.8	0.82	7.1	2.9
37	1011492	50	Male	Rural	1	0	Yes	No	No	1	1	2	2	2	2	2	9.2	8.4	1562	100	3.87	0.61	5.8	2.48
38	994676	47	Male	Rural	1	0	Yes	Yes	No	1	1	2	2	2	2	2	12.7	7.8	1505	120	3.45	0.88	6.4	2.44
39	1004449	42	Male	Rural	4,5	1	Yes	No	No	1	1	2	2	2	2	2	11.5	8.5	2890	80	3.17	0.44	6.7	2.2
40	531989	53	Male	Rural	1	1	Yes	Yes	No	1	1	2	2	2	2	2	8.6	5.1	1581	122	3.07	0.85	6.9	3.46
41	242042	56	Male	Urban	7	1	Yes	Yes	No	1	1	2	2	2	2	2	13.6	4.9	1276	72	1.6	0.94	7.2	3.9
42	1074186	40	Male	Urban	3	0	Yes	No	No	1	1	2	2	2	2	2	11.4	7	1980	70	6.1	0.51	5.8	2.84
43	51491	49	Male	Urban	7	1,2	No	No	No	2	2	1	2	2	2	2	13.2	7.6	1444	150	1.92	1.2	6.9	3.73
44	1057988	44	Male	Urban	1,4,5	0	Yes	No	No	1	1	2	2	2	2	2	10.5	3.8	1368	34	4.2	0.66	6.2	3.47
45	886380	62	Male	Urban	7	1	No	No	No	3	2	2	1	2	2	2	10.6	4.5	1575	80	1.21	1.12	7.2	3.27
46	243380	53	Male	Urban	2	1	Yes	No	No	1	1	2	2	2	2	2	12.8	4	1332	46	0.84	1.2	7.1	4.4
47	982839	65	Male	Rural	7	1	No	No	No	1	1	2	2	2	2	2	9.4	4	1280	198	2.6	1.2	7.8	2.9
48	1023732	46	Male	Rural	1,6	1	Yes	No	No	1	1	2	2	2	2	2	9.2	14	3220	100	7.4	1.26	6.5	2.9
49	501604	46	Female	Rural	1	1	No	No	No	4	2	2	2	1	2	2	7.5	3.2	1152	104	0.38	0.8	7	2.5
50	981067	60	Female	Rural	4,5	1,2	No	No	No	2	2	1	2	2	2	2	8.7	1.9	410	38	0.98	0.9	6.8	3.78
51	190640	65	Female	Urban	7	1,4	No	No	No	3	2	2	1	2	2	2	12.8	3.7	851	120	1.62	0.57	7.7	3.7
52	503381	40	Male	Rural	7	2	No	No	No	2	2	1	2	2	2	2	12.2	7.8	1294	90	1.3	1.2	7.2	3.23
53	679643	56	Male	Rural	7	0	Yes	No	No	1	1	2	2	2	2	2	12.8	6.6	924	90	1.82	0.8	7.6	3.33
54	1025847	47	Male	Rural	5	1	No	Yes	No	2	2	1	2	2	2	2	10.9	7.6	1421	140	1.34	0.82	6.8	4.6
55	1069730	43	Male	Rural	1,3	0	Yes	Yes	No	1	1	2	2	2	2	2	8.8	9.8	1764	60	4.1	0.76	5.7	2.37
56	745240	49	Male	Rural	1	0	Yes	Yes	No	1,4	1	2	2	1	2	2	5.1	3	810	124	1.15	0.68	6.2	2.47

Serial no.	MRD	INR	Na	T.chol	24 hr U.Cr	Ascitis	UGIE	CTP	CTP Class	MELD	Dry Wt.	Height	BMI	MAC	TSFT	MAMC	HG	CHI value	CHI Class	CONUT	Count Class	SGA	SGA GROUP	Complication	Follow up	SBP	HE	HRS	UGI BLEED	HCC
1	1031947	1.5	137	101	0.8	4	3	8	B	16	73.44	175	23.9	19.2	13.2	15.1	21	47.3	2	6	2	B	2	2	3	2	1	2	2	2
2	1065279	2.54	135	66	0.9	4	3	13	C	23	71.4	182	21	21.1	7.8	5.4	19	54.3	2	8	2	C	3	2	5	2	2	2	1	2
3	1069971	1.62	142	132	0.82	1	2,3	6	A	14	80	177	25.55	24.8	14.1	20.3	26	44.5	2	3	1	A	1	2	5	2	2	2	1	2
4	1069989	1.93	135	108	1.18	3	4	11	C	23	113.4	177	36.23	27.8	18.6	21.9	25.6	45.2	2	6	2	B	2	2	6	2	2	2	2	1
5	1082402	1.33	136	141	0.9	2	2,3	7	B	10	85.5	162	32.63	26.8	13.1	22.6	21	58.4	2	8	2	A	1	1	1	2	2	2	2	2
6	49819	1.89	139	152	1.1	1	6	9	B	17	73	170	25.2	25.8	14.5	21.2	32	65.5	1	7	2	A	1	2	3	2	1	2	2	2
7	230171	1.23	136	112	0.9	1	2	7	B	13	93	165	34.9	24.2	11.2	20.6	26.2	42	2	4	1	A	1	1	1	2	2	2	2	2
8	1026005	2.3	135	102	0.84	3	4	10	C	24	62.7	180	19.35	21.2	8.4	18.5	25.5	58.2	2	7	2	B	2	2	3	2	1	2	2	2
9	1062711	1.66	135	75	0.45	3	2	8	B	15	68	157	27.6	22.8	8.4	20.1	18	36.7	3	8	2	B	2	2	5	2	2	2	1	2
10	1074045	1.34	136	178	0.835	2	5	8	B	16	64.6	160	25.2	22.4	31.6	11.62	20.4	71.8	1	2	1	B	2	2	2	1	2	2	2	2
11	1071136	2.44	129	64	0.532	4	8	11	C	21	73.1	150	32.4	21.5	7.8	19	20.4	40.4	2	7	2	B	2	2	2,3	1	1	2	2	2
12	988101	1.44	129	52	0.4	4	2	10	C	14	61	157	24.83	23.5	8.5	20.8	20	28.5	3	12	3	C	3	2	3,5	2	1	2	1	2
13	798867	2.06	132	40	0.51	3	2	13	C	22	60.8	165	22.35	20.1	7.9	17.6	15	36.6	3	9	3	C	3	2	3,4	2	1	1	2	2
14	1002785	2.4	125	40	0.425	2	8	11	C	22	45	168	15.9	20.4	10.4	17.1	20	41.06	2	6	2	B	2	2	2,3	1	1	2	2	2
15	855600	0.99	135	412	0.26	3	2	8	B	6	58.5	165	21.45	25.4	11.4	21.8	19	24.6	3	6	2	B	2	2	2	1	2	2	2	2
16	1008514	2.03	132	125	0.85	2	8	12	C	21	77.9	175	25.45	26.4	12	22.6	25	47.4	2	8	2	B	2	2	3	2	1	2	2	2
17	1087794	1.34	127	206	0.96	3	3	6	A	10	74.7	168	26.8	24.5	11.3	20.9	24	55.8	2	4	1	B	2	2	5	2	2	2	1	2
18	978911	2.2	132	114	0.805	2	2,3	10	B	21	70	168	25.8	22.8	9.9	19.6	23	50	2	9	3	B	2	2	3	2	1	2	2	2
19	968902	1.74	130	25	0.7	3	8	9	B	18	59	168	21.1	22.1	10.1	18.9	21	51.5	2	3	1	B	2	1	1	2	2	2	2	2
20	926935	1.37	139	105	1.1	1	3	7	B	16	76	180	23.4	26.2	14.1	21.7	25	62.9	1	4	1	A	1	2	5	2	2	2	1	2
21	1006414	3.1	132	25	0.851	4	8	12	C	24	72.9	170	25.2	25.2	10.4	21.9	23	50.7	2	8	2	B	2	2	3,4	2	1	1	2	2
22	1112064	1.39	129	201	1.28	2	8	8	B	15	58.4	175	19.08	23.4	9.3	20.4	24	95.2	0	4	1	B	2	1	1	2	2	2	2	2
23	545606	1.81	138	181	0.9	1	2	9	B	20	68	160	26.5	21.3	10.1	18.1	25	73.5	1	4	1	A	1	1	1	2	2	2	2	2
24	1048979	1.24	136	145	0.65	2	3	6	A	10	56	173	18.9	24.8	12.8	20.7	25	50.4	2	4	1	A	1	1	1	2	2	2	2	2
25	1046603	1.24	131	111	1.01	1	3	6	A	10	57	175	18.62	21.2	7.4	18.8	26	76.2	1	4	1	A	1	1	1	2	2	2	2	2
26	903490	1.25	139	113	1.2	1	3	7	B	10	85	168	30.1	26.4	12.8	22.3	25	61.3	1	6	2	A	1	1	1	2	2	2	2	2
27	406692	1.5	138	102	1.2	3	2	7	B	13	97.6	175	31.9	23.9	9.13	21	32	53.4	2	8	2	B	2	1	1	2	2	2	2	2
28	62708	1.21	117	77	0.7	2	3	8	B	14	42.7	160	17.57	24.3	12.1	20.5	19	71.2	1	7	2	B	2	2	3	2	1	2	2	2
29	1023788	1.73	132	185	0.5	1	2	10	C	21	53	162	24.04	22.1	8.9	19.3	17.8	41.01	2	5	2	B	2	2	3	2	1	2	2	2
30	1024765	1.91	129	211	0.549	2	2	11	C	22	55.8	168	20.07	24.3	10.5	21	22.2	42.7	2	5	2	B	2	2	3,4	2	1	1	2	2
31	1008506	1.13	140	103	0.9	1	2	8	B	21	80	177	25.5	22.3	9.8	19.2	22	48.9	2	6	2	B	2	2	3	2	1	2	2	2
32	1029897	1.69	138	98	0.8	3	2,6	8	B	15	60	160	23.43	22.3	11.2	18.7	25	57.9	2	7	2	B	2	2	3	2	1	2	2	2
33	867961	1.4	135	78	0.51	1	2,7	8	B	18	62	168	21.9	18	6.5	15.9	9	35.7	3	8	2	C	3	2	3,4	2	1	1	2	2
34	368820	2.6	132	65	0.4	4	2,3	13	C	23	45.4	160	17.7	20.5	7.5	18.1	15	38.3	3	9	3	C	3	2	2,3,4	1	1	1	2	2
35	934900	1.73	133	190	1.1	2	2,3	11	C	19	90	175	27.7	25.3	10.12	22.1	25	53.1	2	8	2	B	2	2	3	2	1	2	2	2
36	49319	0.82	132	166	1.3	1	3	6	A	9	82.3	173	27.4	29.2	12.4	25.3	28	68.6	1	5	2	A	1	1	1	2	2	2	2	2
37	1011492	1.76	137	54	0.7	3	2	11	C	18	74	168	26.6	23.4	9.6	19.9	22	42.2	2	10	3	B	2	2	2	1	2	2	2	2
38	994676	1.4	135	153	1.11	3	2	10	C	15	72	173	24.4	23.5	10.2	20.2	20	66.4	1	8	2	B	2	1	1	2	2	2	2	2
39	1004449	1.7	184	84	0.92	1	2	9	B	17	81	168	29.24	26.8	11.8	23.09	25	49.3	2	6	2	A	1	1	1	2	2	2	2	2
40	531989	2.01	134	64	0.63	3	3	9	B	18	51.3	165	18.86	25.2	9.9	22	24	53.3	2	5	2	B	2	2	2	1	2	2	2	2
41	242042	0.73	135	162	1.2	1	8	5	A	8	80	168	28.3	24.5	13.4	20.3	28	65.2	1	4	1	A	1	1	1	2	2	2	2	2
42	1074186	2.11	140	98	0.5	2	8	10	C	22	49.5	170	17.1	22.9	9.8	19.8	21	43.9	2	7	2	B	2	2	4	2	2	1	2	2
43	51491	0.85	138	172	0.68	1	3	5	A	11	62	165	22.7	23.9	12.5	19.9	29	47.6	2	2	1	A	1	1	1	2	2	2	2	2
44	1057988	1.86	137	54	0.45	4	2,3	10	C	19	76.5	173	25.5	22.6	8.4	19.9	25	25.5	3	6	2	B	2	2	4	2	2	1	2	2
45	886380	1.35	137	77	0.8	2	2	7	B	12	59.6	162	22.8	23.8	7.8	21.3	20	58.3	2	6	2	B	2	1	1	2	2	2	2	2
46	243380	1.23	137	125	1.4	1	2,3	5	A	10	79	165	29.01	25.5	13.1	21.3	35	77	1	3	1	A	1	1	1	2	2	2	2	2
47	982839	1.33	135	156	1.1	1	4	7	B	15	64	180	19.3	21.3	10.5	18	23.5	74.4	1	6	2	A	1	1	1	2	2	2	2	2
48	1023732	2.4	131	98	0.62	3	3	11	C	26	49.4	170	17.09	21.6	9.8	19	20	54.5	2	7	2	C	3	2	3	2	1	2	2	2
49	501604	1.15	138	124	0.9	3	2	8	B	8	92.9	168	32.9	27.6	10.6	24.2	15.2	42.1	2	7	2	B	2	1	1	2	2	2	2	2
50	981067	1.09	136	162	0.42	1	2	5	A	7	56.7	157	23	21.3	10	18.16	21	41.1	2	4	1	A	1	1	1	2	2	2	2	2
51	190640	1.21	133	87	0.96	1	5	5	A	10	78	160	30.4	22.6	11	19.1	25	74	1	5	2	A	1	1	1	2	2	2	2	2
52	503381	1.24	136	165	0.853	2	3	7	B	12	78.85	160	30.8	22.6	10.2	19.3	27.5	47	2	4	1	B	2	1	1	2	2	2	2	2
53	679643	1.01	140	88	0.95	1	2,3	6	A	9	87	180	26.8	24.8	13	20.7	36	47.4	2	7	2	A	1	1	1	2	2	2	2	2
54	1025847	1.23	138	156	0.85	2	2	6	A	10	77.9	168	27.6	23.8	11.1	20.3	30.5	47.6	2	2	1	A	1	1	1	2	2	2	2	2
55	1069730	2.6	137	72	0.9	3	2,3	12	C	22	93.8	175	30.6	22.8	9.3	19.8	22.3	41.7	2	9	3	B	2	2	2,3	1	1	2	2	2
56	745240	1.19	135	210	1.06	2	8	8	B	9	74.1	170	25.6	20.3	8.1	17.7	22	62.1	1	8	2	B	2	1	1	2	2	2	2	2

Serial no.	MRD	Age	Sex	Address	C/C	Past H/O	Alcohol	Smoking	IVDU	Etiology	ALCOHOL	NASH	HBV	HCV	AUTOIMMUNE	BCS	HB	TLC	T. Lymphocyte	Platelet	Total Bil.	Creat	T. protein	Albumin
57	1011819	60	Male	Urban	1	0	Yes	No	No	1	1	2	2	2	2	2	7	5.7	1824	122	3.13	1.02	5.7	2.61
58	812337	52	Male	Rural	2	1	Yes	No	No	1	1	2	2	2	2	2	9.6	4.7	987	80	0.8	0.65	6.6	3.92
59	461033	45	Male	Rural	7	1,7	No	No	No	2	2	1	2	2	2	2	14.5	4	1400	89	1.2	0.75	6.8	2.98
60	1007204	46	Male	Urban	7	2	Yes	Yes	No	1,2	1	1	2	2	2	2	10.9	7.4	2072	90	1.72	1.05	6.7	3.57
61	1012322	45	Male	Rural	2	0	Yes	Yes	No	1	1	2	2	2	2	2	8.6	12	2640	197	3.03	0.65	5.4	2.59
62	974659	36	Male	Urban	2	0	Yes	No	No	1,4	1	2	2	1	2	2	10.7	6.2	1178	110	0.89	1.3	7.3	3.08
63	1014773	40	Male	Rural	3	0	Yes	No	No	1	1	2	2	2	2	2	8.8	5.2	1612	106	7.6	0.81	6.4	3.89
64	990072	40	Male	Rural	1	1	No	No	No	4	2	2	2	1	2	2	8.9	11	1848	84	3.5	1.18	7.3	2.73
65	35417	52	Male	Urban	7	2	No	No	No	2	2	1	2	2	2	2	9	5.4	1296	140	0.88	0.99	7	3.05
66	1020315	60	Male	Rural	3,4,5	1,2	No	No	No	2	2	1	2	2	2	2	10.2	6.1	1891	38	6.2	0.4	5.7	2.81
67	100342	50	Male	Rural	4,5	1	Yes	No	No	1	1	2	2	2	2	2	12.2	14	3080	102	9.4	0.66	7	3.03
68	1056622	48	Male	Urban	7	1	Yes	Yes	No	1	1	2	2	2	2	2	13.6	4.4	924	100	1.7	0.65	6.9	3.05
69	973867	63	Male	Urban	7	1	No	Yes	No	2	2	1	2	2	2	2	9.6	5.1	1150	120	2.1	0.87	7.4	3.54
70	670996	38	Female	Urban	7	1	No	No	No	2	2	1	2	2	2	2	13.5	9.3	4371	160	1.95	1.2	8.45	3.25
71	67109	57	Female	Rural	4,6	1	No	No	No	2	2	1	2	2	2	2	6.8	2.9	957	42	1.82	1.12	5.7	3.11
72	1085677	55	Male	Rural	2,3	1	Yes	Yes	No	1	1	2	2	2	2	2	12.2	5	670	292	2.4	0.68	6.5	2.76
73	663728	41	Male	Urban	1,2	1	No	No	No	2	2	1	2	2	2	2	10.9	4.4	1332	82	1.77	0.64	6.3	2.15
74	932725	55	Male	Rural	7	1,2	No	No	No	2,3	2	1	1	2	2	2	13.2	7.8	2496	160	1.3	0.92	6.8	3.6
75	61953	30	Male	Urban	7	1,2	No	No	No	2	2	1	2	2	2	2	12.2	4.5	1423	103	0.99	0.65	6.9	3.4
76	1030554	50	Female	Rural	1,4	1,2	No	No	No	2	2	1	2	2	2	2	7.8	2.4	472	64	1.02	0.81	8	3.18
77	636108	60	Male	Urban	7	1	No	No	No	2	2	1	2	2	2	2	11.6	5.3	1012	50	1.3	0.92	7.2	4.3
78	962649	64	Female	Urban	5	1,2	No	No	No	2	2	1	2	2	2	2	12	5.3	1211	150	0.67	0.99	6.8	3.47
79	979359	60	Female	Rural	4	1,2	No	No	No	2	2	1	2	2	2	2	11.9	7.2	1080	115	1.32	0.85	6.8	3.7
80	118965	44	Male	Rural	7	1,2	No	No	No	2	2	1	2	2	2	2	11.8	5.9	1298	124	1.63	0.62	6.95	2.83
81	886380	60	Male	Rural	1	1	No	No	No	3	2	2	1	2	2	2	9.1	2.5	422	62	2.1	1.08	6.6	2.9
82	44645	61	Male	Rural	3	1	Yes	No	No	1	1	2	2	2	2	2	13.5	2.7	460	92	1.47	0.82	7.96	3.34
83	70847	44	Female	Rural	1	1,2	No	No	No	2	2	1	2	2	2	2	9.8	7.7	2387	216	1.42	0.91	5.3	2.42
84	984891	46	Male	Rural	4,5	2	No	No	No	2	2	1	2	2	2	2	8.6	5.9	1239	60	1.49	0.75	6.3	3.6
85	981651	45	Male	Rural	1,3	0	Yes	No	No	1	1	2	2	2	2	2	8.7	10.5	1552	70	4.08	1.1	4.3	1.59
86	984060	54	Male	Rural	1,3	0	Yes	No	No	1	1	2	2	2	2	2	8	6.1	1861	38	7.4	1.2	5.4	2.29
87	983760	36	Male	Urban	2	0	Yes	Yes	No	1,3	1	2	1	2	2	2	7.2	5.3	1562	70	2.19	0.7	5.6	1.96
88	984199	60	Male	Rural	1	0	No	No	No	2	2	1	2	2	2	2	10.7	7.5	2450	50	1.38	1.3	6.6	3.11
89	981142	47	Male	Rural	3	0	Yes	No	No	1	1	2	2	2	2	2	9.7	6.9	1862	90	1.89	0.71	5.8	2.3
90	912931	43	Male	Rural	1,3,6	1	Yes	No	No	1	1	2	2	2	2	2	7.2	7.1	1900	78	8.1	0.89	7.2	2.17
91	999630	50	Male	Rural	1,6	1	Yes	No	No	1	1	2	2	2	2	2	7.8	5.7	1254	69	1.64	1.4	6.2	2.73
92	985270	62	Male	Rural	2	0	No	No	No	2	2	1	2	2	2	2	10.6	6.8	1700	96	1.89	0.93	5.8	2.66
93	997959	50	Male	Rural	1,3	0	Yes	Yes	No	1	1	2	2	2	2	2	8.5	7.5	2625	112	7.4	0.54	5.4	2.65
94	985697	52	Male	Rural	2	0	Yes	No	No	1	1	2	2	2	2	2	8.2	3.6	1152	43	3.45	0.75	7.6	4.7
95	884116	45	Male	Rural	1,6	0	Yes	No	No	1,4	1	2	2	1	2	2	7.8	4.1	1266	102	1.2	1.03	7	2.21
96	251448	41	Male	Rural	7	2,3,6	Yes	No	No	1,2	1	1	2	2	2	2	11.8	4.9	1470	104	1.4	0.48	6.5	3.39
97	318616	57	Male	Rural	2	2	Yes	No	No	1,2	1	1	2	2	2	2	11.3	7.2	1800	65	0.71	0.73	6.6	3.95
98	1044161	64	Male	Rural	2,4	1	Yes	No	No	1	1	2	2	2	2	2	14.4	6.9	1242	70	0.34	0.76	6.1	3.5
99	1041169	49	Male	Urban	1,3	0	Yes	No	No	1	1	2	2	2	2	2	9	4.6	1020	44	4.1	1.09	7.2	3.12
100	815346	42	Male	Urban	1,2	0	Yes	No	No	1	1	2	2	2	2	2	7.7	3.5	890	46	3.04	0.72	6.2	2.39
101	998034	30	Male	Rural	1,3	0	Yes	Yes	No	1	1	2	2	2	2	2	7.4	8.9	1780	189	2.9	0.41	5.4	1.81
102	90188	54	Male	Rural	4,5	1	Yes	No	No	1,4	1	2	2	1	2	2	9.1	5.3	1113	52	2.87	0.67	7.4	3.04
103	1022440	42	Female	Rural	5	0	No	No	No	2	2	1	2	2	2	2	13.8	6.4	1792	104	1.6	1.05	7.2	3.8
104	1034904	52	Male	Rural	1,5,6	1,2	Yes	No	No	1,2	1	1	2	2	2	2	7.6	5.1	1122	155	2.03	1.1	6.3	2.74
105	85803	58	Male	Urban	4	1,2	Yes	Yes	No	1,2	1	1	2	2	2	2	9.7	3.5	875	42	5.6	0.67	8.54	2.45
106	603311	59	Male	Urban	5	1	Yes	No	No	1	1	2	2	2	2	2	13.1	4.6	1334	112	0.96	0.72	6.95	3.32
107	1009370	45	Male	Urban	5	1	Yes	Yes	No	1	1	2	2	2	2	2	12	9	2340	263	1.64	0.89	9.6	3.88
108	979671	58	Male	Urban	1	1	Yes	No	No	1	1	2	2	2	2	2	6.6	6.2	1488	134	4.1	1.31	9.8	2.56
109	1017186	53	Male	Urban	3	1	Yes	No	No	1	1	2	2	2	2	2	9.4	11	2310	142	5.7	0.88	6.7	2.23
110	1031943	45	Male	Urban	7	1	No	No	No	2	2	1	2	2	2	2	13.6	11	3080	166	1.5	0.98	6.9	3.5
111	979670	51	Male	Urban	7	1,2	No	No	No	2	2	1	2	2	2	2	12.7	4	1000	154	2.63	0.95	7.25	3.71
112	807296	49	Male	Urban	7	1	No	No	No	2	2	1	2	2	2	2	11.2	6.9	2139	110	1.34	0.82	7.1	3.34

Serial no.	MRD	INR	Na	T.chol	24 hr U.Cr	Ascitis	UGIE	CTP	CTP Class	MELD	Dry Wt.	Height	BMI	MAC	TSFT	MAMC	HG	CHI value	CHI Class	CONUT	Count Class	SGA	SGA GROUP	Complication	Follow up	SBP	HE	HRS	UGI BLEED	HCC
57	1011819	1.66	131	108	0.68	3	2,6	10	C	17	68.5	168	24.2	26.2	12.1	22.4	22	43.1	2	6	2	B	2	2	3	2	1	2	2	2
58	812337	1.24	135	132	0.97	1	2	5	A	9	95	180	29.3	29	14	24.6	33	44.3	2	4	1	A	1	1	1	2	2	2	2	2
59	461033	0.98	136	116	0.8	1	2,5	6	A	7	71	157	28.8	24.2	12.1	20.4	30	48.9	2	7	2	A	1	1	1	2	2	2	2	2
60	1007204	1.24	141	125	0.6	1	2,3	5	A	11	64	170	22	24.6	13.2	20.4	25	40.7	2	2	1	A	1	1	1	2	2	2	2	2
61	1012322	1.22	140	141	0.89	2	8	10	C	13	63	170	21.7	25.2	9.3	22.2	24	61.4	1	5	2	B	2	2	3	2	1	2	2	2
62	974659	1.17	132	155	0.9	2	2,3	7	B	11	64	170	22	23.5	10	20.3	21	61.1	1	5	2	A	1	1	1	2	2	2	2	2
63	1014773	2.7	136	175	0.8	2	2,3	10	C	25	75	180	23.14	26.2	11	22.7	23	46.3	2	2	1	B	2	2	3	2	1	2	2	2
64	990072	1.34	131	84	0.49	3	3	10	C	16	54	160	21.1	15	5.07	13.4	15	39.4	3	7	2	C	3	2	2,3	1	1	2	2	2
65	35417	1.28	133	113	0.72	2	3	7	B	9	57.1	173	19.04	22.5	9.8	19.4	26	54.8	2	5	2	A	1	2	5	2	2	2	1	2
66	1020315	1.82	127	42	0.9	3	2,3	10	C	20	70.3	177	22.4	21.8	7.1	19.6	15	55.6	2	7	2	C	3	2	3,4	2	1	1	2	2
67	100342	2.1	134	113	0.9	4	3	12	C	23	81	180	25	23.9	9.6	20.89	27.5	48.3	2	4	1	B	2	2	3,4	2	1	1	2	2
68	1056622	1.25	135	210	1.3	1	2	6	A	11	88	178	27.7	25.2	13.1	21.1	38	64.2	1	4	1	A	1	1	1	2	2	2	2	2
69	973867	1.1	141	85	1.1	1	3	6	A	10	83	182	24.15	22.4	10.2	19.1	29	57.6	2	5	2	B	2	1	1	2	2	2	2	2
70	670996	1.34	133	135	0.75	1	2	6	A	14	56	162	21.3	23.5	12	19.7	18	74.4	1	4	1	A	1	1	1	2	2	2	2	2
71	67109	1.29	142	84	0.54	3	3	7	B	13	42.7	150	18.9	20.5	6.5	18.4	12	72	1	7	2	B	2	2	3,5	2	1	2	1	2
72	1085677	1.46	136	151	0.8	1	8	8	B	14	64	172	21.6	23.2	10.5	19.9	26	54.3	2	8	2	B	2	2	3	2	1	2	2	2
73	663728	1.5	135	120	0.58	3	3	9	B	13	62.7	178	19.8	23.9	12.1	20.1	32	40.2	2	7	2	B	2	2	2,5	1	2	2	1	2
74	932725	0.82	137	176	1.5	1	8	5	A	7	93.2	182	28.1	25.3	13.1	21.1	31	69.7	1	1	1	A	1	1	1	2	2	2	2	2
75	61953	1.02	135	162	1.1	1	8	6	A	7	76.3	165	28.02	23.9	11.5	20.2	40.2	62.6	1	4	1	A	1	1	1	2	2	2	2	2
76	1030554	1.31	145	114	0.5	3	2	7	B	10	51	157	20.7	21.4	8.8	18.6	11	42.6	2	7	2	B	2	2	5	2	2	2	1	2
77	636108	0.65	136	120	0.8	1	8	5	A	7	74	167	26.5	23.9	10.2	20.6	29	47	2	4	1	A	1	1	1	2	2	2	2	2
78	962649	1.21	133	212	1.1	1	2	6	A	9	65.5	165	24.05	20.9	9.5	17.9	16	93.2	0	3	1	A	1	2	3	2	1	2	2	2
79	979359	0.95	132	134	0.72	1	8	5	A	7	65.9	157	26.7	22.9	9.1	20.04	20	60.6	1	4	1	A	1	1	1	2	2	2	2	2
80	118965	2.1	130	82	1.34	2	3	8	B	17	75	168	26.5	22.8	10	19.9	24	77.6	1	8	2	B	2	2	2	1	2	2	2	2
81	886380	1.53	137	112	0.8	3	3	8	B	15	68	165	24.9	23.9	9.3	20.9	21	51.1	2	9	3	B	2	2	3,4,5	2	1	1	1	2
82	44645	1.21	139	170	1.32	1	2,3	6	A	10	89	177	28.4	24.5	11	21	28	64.4	1	6	2	A	1	1	1	2	2	2	2	2
83	70847	1.33	137	161	0.89	4	3	9	B	11	94	170	32.5	20.4	7.2	18.1	9	52.6	2	7	2	C	3	2	2,3,4	1	1	1	2	2
84	984891	1.18	136	51	1.3	2	2	6	A	11	81	175	26.4	23.4	9.9	20.2	28	69.7	1	5	2	A	1	2	5	2	2	2	1	2
85	981651	2.45	126	40	0.54	4	3	13	C	23	76.5	175	24.9	21	6.8	18.8	17	30.6	3	10	3	C	3	2	2,3,4	1	1	1	2	2
86	984060	2.2	134	68	0.42	4	4	12	C	25	69.3	165	25.4	21.3	8.1	18.7	19	26.3	3	9	3	C	3	1	3,5	2	1	2	1	2
87	983760	1.79	132	59	0.91	3	3	10	C	16	85	165	31.2	23.5	10.3	20.2	26	46	2	7	2	B	2	1	1	2	2	2	2	2
88	984199	1.53	138	110	1.05	2	2	7	B	15	85	175	27.7	22.3	9.8	19.2	25	53.7	2	4	1	B	2	1	1	2	2	2	2	2
89	981142	1.51	133	130	1.2	2	3	8	B	13	76	182	22.9	33	14	28.6	35	68.6	1	8	2	A	1	1	1	2	2	2	2	2
90	912931	2.4	132	58	1.02	2	2,3	12	C	24	76	175	24.8	29	12.3	25.1	21	58.3	2	9	3	B	2	2	2,3	1	1	2	2	2
91	999630	1.24	141	88	0.257	4	2,7	9	B	14	72	170	24.9	24.6	10.1	21.4	28	15.5	3	8	2	B	2	2	3	2	1	2	2	2
92	985270	1.41	141	114	0.78	1	2	7	B	13	67	175	21.8	27.4	12.3	23.5	28	50.6	2	6	2	A	1	1	1	2	2	2	2	2
93	997959	1.49	134	131	0.8	2	2,3	10	C	18	71	170	24.5	26.4	9.9	23.2	21	48.9	2	6	2	B	2	2	3	2	1	2	2	2
94	985697	1.78	133	116	0.9	2	2	9	B	18	61.7	168	21.8	19.3	9.8	16.2	24	63.4	1	4	1	A	1	2	3	2	1	2	2	2
95	884116	1.64	130	152	1.13	3	4,5	9	B	13	75	178	23.6	23.5	11	20.1	21	65.5	1	8	2	B	2	2	2,3	1	1	2	2	2
96	251448	1.52	133	171	1.2	1	2	6	B	12	62.7	165	23.03	23.4	11.2	19.9	24	83.2	0	4	1	A	1	1	1	2	2	2	2	2
97	318616	1.01	142	126	0.716	1	8	5	A	7	78	173	26.06	30.1	12.3	26.2	22	39.9	3	2	1	B	2	2	3	2	1	2	2	2
98	1044161	1	144	95	0.86	1	2	6	A	6	65.5	160	25.5	26.8	11.1	23.3	30	57.08	2	4	1	A	1	1	1	2	2	2	2	2
99	1041169	1.75	133	98	1.46	2	3	10	C	19	76.5	174	25.2	22.9	8.5	20.2	26	82.9	0	7	2	B	2	2	2	1	2	2	2	2
100	815346	1.8	134	64	0.83	3	3	11	C	17	71	176	22.9	22.5	8.8	19.7	21	50.8	2	11	3	B	2	2	2,3	1	1	2	2	2
101	998034	2.08	137	52	0.23	4	3	12	C	19	52	168	18.4	21.3	9.1	18.4	16	19.2	3	9	3	C	3	2	2,3	1	1	2	2	2
102	90188	1.34	131	74	0.68	1	2	7	B	14	76	175	24.8	23	10.5	19.7	22.5	38.9	3	7	2	B	2	1	1	2	2	2	2	2
103	1022440	0.45	136	150	0.79	1	2	5	A	9	78	170	26.9	24.3	12	20.5	24	56.2	2	1	1	A	1	1	1	2	2	2	2	2
104	1034904	1.78	128	85	0.45	3	3	10	C	16	52	173	17.37	21.1	8	18.5	18	37.6	3	9	3	C	3	2	2,3	1	1	2	2	2
105	85803	1.34	138	76	0.6	1	2	9	B	16	55	170	19.03	21.5	9	18.7	19	47.4	2	9	3	B	2	2	3	2	1	2	2	2
106	603311	2.1	135	136	0.9	1	3	7	B	15	70	178	22.09	25.2	11.4	21.6	35	55.9	2	5	2	A	1	1	1	2	2	2	2	2
107	1009370	1.27	142	124	0.8	3	2	6	A	11	66	170	22.8	24.3	10.1	21.1	24	52.7	2	2	1	A	1	1	1	2	2	2	2	2
108	979671	2.1	136	62	0.24	3	2,3	11	C	23	49.5	167	17.7	18.5	6.5	16.5	15	21	3	8	2	C	3	2	2,3,4	1	1	1	2	2
109	1017186	1.98	134	84	0.45	3	2	11	C	21	58	175	18.9	25.3	10	22.1	21	33.7	3	9	3	B	2	1	1	2	2	2	2	2
110	1031943	1.32	137	122	1.1	1	8	6	B	11	66	160	25.7	24.8	10.2	21.5	28	72.4	1	2	1	A	1	1	1	2	2	2	2	2
111	979670	1.62	138	179	1.4	1	2	5	A	15	98	180	30.2	23.6	8.9	20.8	39	62.1	1	3	1	A	1	1	1	2	2	2	2	2
112	807296	0.92	137	112	1.3	1	2	6	A	8	89.5	174	29.5	26.2	10	23.06	26	63.1	1	4	1	A	1	1	1	2	2	2	2	2

Serial no.	MRD	Age	Sex	Address	C/C	Past H/O	Alcohol	Smoking	IVDU	Etiology	ALCOHOL	NASH	HBV	HCV	AUTOIMMUNE	BCS	HB	TLC	T. Lymphocyte	Platelet	Total Bil.	Creat	T. protein	Albumin
113	1042412	57	Male	Rural	1	1	Yes	No	No	1	1	2	2	2	2	2	10.9	4.5	1125	88	1.22	0.84	7.1	2.7
114	1056386	58	Male	Urban	7	1	No	No	No	2	2	1	2	2	2	2	9.2	6.1	1268	123	3.91	0.85	6.9	3.84
115	1007235	55	Male	Urban	7	1,2,3	No	No	No	2	2	1	2	2	2	2	13.7	7.2	2304	153	2.32	0.24	6.96	3.82
116	1038629	47	Male	Rural	1,5	1	Yes	Yes	No	1	1	2	2	2	2	2	7.8	6.6	1452	142	0.97	1.07	7.1	3.38
117	717955	31	Male	Rural	7	1	No	No	No	2	2	1	2	2	2	2	10.8	6.4	1920	154	2.6	0.65	7.29	3.71
118	75465	53	Male	Rural	7	1	Yes	Yes	No	1	1	2	2	2	2	2	12.8	4.5	855	56	1.41	0.78	6.45	2.89
119	912306	62	Male	Urban	1,2	1,2	Yes	Yes	No	1,2	1	1	2	2	2	2	8	12	2800	134	1.89	0.68	7.4	2.38
120	1035124	47	Male	Urban	1,3	1,2	Yes	Yes	No	1,2	1	1	2	2	2	2	8.8	8	1856	130	3.2	1.04	6.5	2.67
121	1034823	47	Male	Rural	1,3,4	1	No	No	No	2	2	1	2	2	2	2	8.5	3.8	864	60	0.89	1.2	8.4	2.25
122	1055307	32	Male	Rural	3,4	0	Yes	Yes	No	1	1	2	2	2	2	2	6.4	11	3260	317	7.5	1.04	6.3	2.45
123	265140	58	Male	Rural	2	2,3	No	No	No	2	2	1	2	2	2	2	8.2	4	1040	134	1.35	0.96	7.1	2.57
124	62573	58	Male	Urban	1,3	1,6	No	No	No	2	2	1	2	2	2	2	7.8	3.4	884	120	5.1	0.53	6.8	2.66
125	1017391	40	Male	Rural	3,4	1,3	Yes	Yes	No	1	1	2	2	2	2	2	10.4	6.1	1098	138	8.1	0.73	5.5	2.6
126	994220	60	Male	Rural	4,5	1,2	No	No	No	2	2	1	2	2	2	2	6.9	5.7	1368	128	2.41	1.3	7.4	2.59
127	946511	44	Male	Urban	2	0	Yes	Yes	No	1	1	2	2	2	2	2	11.9	4.6	1150	136	2.11	0.98	6.5	3.2
128	551484	60	Male	Urban	3	1	Yes	Yes	No	1	1	2	2	2	2	2	8.1	5.6	1232	36	3.77	0.91	4.3	2.2
129	999352	46	Male	Rural	3	2,3	Yes	Yes	No	1,2	1	1	2	2	2	2	9.4	8.2	2050	100	9.2	0.78	5.7	2.39
130	1017739	63	Female	Rural	2	0	No	No	No	2	2	1	2	2	2	2	9.7	3.4	952	72	4.61	1.3	6.3	3.47
131	986901	60	Male	Rural	1	2,5	No	No	No	2,4	2	1	2	1	2	2	8.5	10.6	2544	110	0.29	1.17	6.2	2.5
132	1005220	64	Male	Rural	1	1,5	Yes	No	No	1,4	1	2	2	1	2	2	12.8	12	3720	110	1.87	0.94	5.6	3.29
133	555030	41	Male	Rural	1	1,2	Yes	Yes	No	1,2	1	1	2	2	2	2	6.7	6	1440	124	1.91	1.23	6.2	1.98
134	863381	61	Male	Urban	4,5	5	Yes	No	No	1,4	1	2	2	1	2	2	7.1	4.3	1140	84	1.61	1.04	5.3	2.67
135	915859	30	Male	Rural	1,4,5	0	Yes	Yes	No	1	1	2	2	2	2	2	9.7	5.2	1300	70	5.1	1.27	5.6	2.57
136	519335	37	Male	Rural	1	0	Yes	Yes	No	1	1	2	2	2	2	2	8.4	5.4	1296	57	1.93	1.2	6	2.6
137	1022569	39	Male	Rural	1,3	0	Yes	Yes	No	1	1	2	2	2	2	2	8	1.3	286	22	4.03	1.3	7	1.86
138	832293	62	Male	Rural	4	1	Yes	No	No	1	1	2	2	2	2	2	10.1	4.8	1152	62	4.89	0.9	6.4	2.83
139	1021530	45	Male	Rural	5	0	Yes	No	No	1	1	2	2	2	2	2	9.2	7.5	2100	100	0.47	0.88	5	2.39
140	1010723	40	Male	Rural	1,3	2	Yes	No	No	1,2	1	1	2	2	2	2	7.1	4.6	1288	50	4.4	0.98	6.3	2.79
141	1023735	62	Female	Rural	4	0	No	No	No	2	2	1	2	2	2	2	10.2	3.6	648	74	1.72	1.2	5.7	2.33
142	151220	48	Male	Urban	1,2	2,5	No	No	No	2,4	2	1	2	1	2	2	6.9	2.7	837	50	2.15	1.2	5.9	2.22
143	1008314	43	Male	Rural	2,4	0	Yes	Yes	No	1	1	2	2	2	2	2	8.5	12	4200	120	1.1	0.56	5.6	2.53
144	1014900	45	Male	Urban	7	1	Yes	Yes	No	1	1	2	2	2	2	2	8.9	11	3410	265	4.4	1.06	7.2	3.3
145	1011999	34	Male	Rural	4,5	1	Yes	No	No	1	1	2	2	2	2	2	8.5	9.7	3104	100	2.74	0.9	5.2	2.68
146	1014915	49	Male	Urban	1,3	2,3	Yes	No	No	1,2	1	1	2	2	2	2	11.5	8.8	2288	102	4.1	1.17	8.5	2.68
147	1010700	49	Male	Rural	1,2,3	2	Yes	No	No	1,2	1	1	2	2	2	2	11	5.9	1829	40	1.76	0.96	6.3	2.82
148	1011331	51	Male	Rural	1,3	0	Yes	Yes	No	1	1	2	2	2	2	2	7.2	3	860	48	3.9	1.31	6.9	2.1
149	508342	59	Female	Rural	5,6	1,2,6	No	No	No	2	2	1	2	2	2	2	8.9	1.4	378	56	1.7	1.28	7.6	3.2
150	76607	64	Male	Urban	1,6	0	No	No	No	2	2	1	2	2	2	2	6.9	3.8	1064	120	2.48	1.32	6.9	2.5
151	985054	63	Female	Rural	1	2	No	No	No	2	2	1	2	2	2	2	12.7	2.6	806	44	1.94	0.88	7.3	2.1
152	989164	64	Male	Rural	2	5	No	No	No	4	2	2	2	1	2	2	12.8	6.8	2176	132	2.06	1.1	7.3	2.9
153	996177	48	Male	Urban	1	1	Yes	No	No	1	1	2	2	2	2	2	7.6	7	1540	90	1.82	1.28	5.9	2.41
154	1024763	45	Male	Rural	2	1	Yes	No	No	1	1	2	2	2	2	2	10.6	6.1	1891	82	1.62	0.52	6.6	2.6
155	992510	61	Female	Urban	4	2,3	No	No	No	2	2	1	2	2	2	2	8.2	4.6	1334	80	0.6	0.83	7.6	3.95
156	831715	51	Male	Urban	6	1	No	No	No	2	2	1	2	2	2	2	13.6	7.8	2146	150	1.49	0.78	6.3	3.3
157	789074	65	Male	Rural	7	1,2	Yes	No	No	1,2	1	1	2	2	2	2	8.7	4.8	1488	50	1.97	1.2	6.2	2.8
158	70366	46	Male	Urban	5	1	No	No	No	2	2	1	2	2	2	2	14.2	4.7	1410	90	1.79	0.95	6.6	2.34
159	932348	41	Male	Urban	2	0	Yes	No	No	1	1	2	2	2	2	2	8.6	6.7	1675	120	4.8	0.6	5.9	2.83
160	784566	61	Female	Urban	1,3	1	No	No	No	2	2	1	2	2	2	2	7.5	4.4	968	94	3.9	0.7	6.5	2.42
161	1012667	54	Male	Rural	2	2	No	No	No	2	2	1	2	2	2	2	9.8	7.5	2175	54	1.72	1.03	6.7	3.1
162	1004534	28	Male	Rural	3	0	No	No	No	5	2	2	2	2	1	2	12.5	11	3520	212	5.1	0.89	6.6	4.27
163	1021494	50	Female	Rural	3,4,5	0	No	No	No	2	2	1	2	2	2	2	9	9.7	1940	110	4.9	1.3	5.8	2.7
164	752659	63	Male	Urban	1	0	Yes	Yes	No	1	1	2	2	2	2	2	8.5	10.6	2756	50	3.46	1.23	6.5	3.22
165	923948	50	Male	Urban	1,3	1	Yes	No	No	1	1	2	2	2	2	2	10.4	7.4	2294	60	4.28	0.67	5.2	2.19

Serial no.	MRD	INR	Na	T.chol	24 hr U.Cr	Ascitis	UGIE	CTP	CTP Class	MELD	Dry Wt.	Height	BMI	MAC	TSFT	MAMC	HG	CHI value	CHI Class	CONUT	Count Class	SGA	SGA GROUP	Complication	Follow up	SBP	HE	HRS	UGI BLEED	HCC
113	1042412	1.47	136	108	1.23	3	3	8	B	11	81	171	27.7	24.3	10	21.1	23	66	1	8	2	B	2	2	5	2	2	2	1	2
114	1056386	1.5	138	130	0.9	1	3	6	A	16	80	173	26.7	24.6	10.8	21.2	26	48.9	2	3	1	A	1	1	1	2	2	2	2	2
115	1007235	1.35	140	101	0.9	1	1	5	A	13	73.4	158	29.2	25.3	11.5	21.6	28	53.3	2	2	1	A	1	1	1	2	2	2	2	2
116	1038629	2.01	138	98	0.77	4	3	9	B	15	68	162	25.9	23.6	9.5	20.6	25	49.2	2	6	2	B	2	2	2,5	1	2	2	1	2
117	717955	1.62	138	161	1.4	1	1	6	A	15	86	174	28.4	25.2	11	21.7	31	70.7	1	1	0	A	1	1	1	2	2	2	2	2
118	75465	1.29	137	116	0.9	1	3	6	A	11	65	162	24.7	22.6	9	19.8	35	60.2	1	8	2	A	1	2	5	2	2	2	1	2
119	912306	1.59	131	46	0.96	3	2	8	B	14	65	170	21.7	22	9.1	19.1	20	64.2	1	9	3	B	2	2	2,3,4	1	1	1	2	2
120	1035124	1.83	125	134	0.45	4	3	12	C	18	59.4	162	22.6	21.7	7.5	19.4	18	32.9	3	6	2	C	3	2	2,3	1	1	2	2	2
121	1034823	1.38	143	114	0.61	3	2	8	B	12	70	170	24.2	23.5	10	20.3	23	37.8	3	10	3	B	2	2	3	2	1	2	2	2
122	1055307	1.33	141	136	0.71	2	2,3	10	C	18	64.7	182	19.5	23.9	10	20.8	25	47.7	2	8	2	B	2	2	3	2	1	2	2	2
123	265140	1.38	139	110	0.9	2	8	8	B	11	71.5	179	22.3	23.2	9.5	20.2	21	54.7	2	8	2	B	2	1	1	2	2	2	2	2
124	62573	1.67	141	61	1.17	4	3	11	C	18	100.8	179	31.4	27.4	11.5	23.7	24	50.4	2	9	3	B	2	2	2,3	1	1	2	2	2
125	1017391	1.79	136	44	0.4	1	2	10	C	21	59.8	170	20.6	20.3	7	18.1	21	29.08	3	9	3	C	3	2	3,5	2	1	2	1	2
126	994220	1.24	126	88	0.42	1	2,7	8	B	15	56	170	19.37	22.3	10	19.2	20	32.6	3	8	2	B	2	2	3	2	1	2	2	2
127	946511	1.2	136	122	1.5	2	8	8	B	11	91	173	30.4	25.3	12	21.5	27	71.6	1	4	1	A	1	1	1	2	2	2	2	2
128	551484	1.7	150	162	1.1	2	3	11	C	17	80.7	173	26.9	23.6	10	20.46	27	68.3	1	8	2	B	2	2	5	2	2	2	1	2
129	999352	2.2	141	115	0.93	1	3	10	C	24	66.5	168	23.5	23.5	11	20	25	60.8	1	8	2	A	1	2	3	2	1	2	2	2
130	1017739	2.07	149	140	0.45	2	8	10	C	23	62	157	25.1	21.2	8.5	18.5	13	40.3	2	5	2	B	2	2	3	2	1	2	2	2
131	986901	1.03	141	68	0.8	2	8	8	B	8	65	165	23.8	20.4	8	17.8	20	53.5	2	7	2	B	2	1	1	2	2	2	2	2
132	1005220	1.41	137	60	0.53	3	2	7	B	13	57	177	18.19	23	9.8	19.9	20	40.4	2	5	2	B	2	2	2,3	1	1	2	2	2
133	555030	1.92	138	40	0.67	3	2	9	B	18	51.5	168	18.24	23.2	8	20.6	20	56.5	2	8	2	C	3	2	3	2	1	2	2	2
134	863381	1.6	137	164	1.23	1	2	7	B	14	64	165	23.5	27.8	12	24.03	28	83.5	0	6	2	A	1	1	1	2	2	2	2	2
135	915859	1.79	135	81	0.54	3	3	11	C	21	64	170	22.1	22	9	19.1	21	36.6	3	8	2	C	3	2	3,5	2	1	2	1	2
136	519335	1.45	136	88	0.9	3	8	8	B	15	82.5	182	24.9	22.5	9.5	19.5	24	47.4	2	8	2	B	2	2	3	2	1	2	2	2
137	1022569	1.8	135	42	0.74	3	2	12	C	21	64	170	22.1	21.5	8.5	18.8	21	64.5	2	12	3	C	3	2	2,3	1	1	2	2	2
138	832293	1.79	131	56	0.62	2	3	10	C	19	47	160	18.35	22.3	7.8	19.8	21	57.3	2	9	3	C	3	2	2,3,5	1	1	2	1	2
139	1021530	1.18	140	118	0.81	2	3	8	B	8	63	169	22.05	26.4	11.2	22.8	24	55.2	2	8	2	B	2	2	5	2	2	2	1	2
140	1010723	0.95	132	98	1.1	3	2,3	9	B	12	85	176	27.44	20.4	8	17.8	23	56.2	2	8	2	B	2	2	3	2	1	2	2	2
141	1023735	1.37	139	82	0.68	1	2	7	B	14	49.5	165	18.2	21.8	8.5	19.1	14	59.7	2	10	3	B	2	1	1	2	2	2	2	2
142	151220	1.46	140	81	1.59	3	3	9	B	15	114	186	32.9	32	13.2	27.8	21	60.6	1	11	3	B	2	2	5	2	2	2	1	2
143	1008314	1.96	133	156	1.2	2	8	9	B	14	73	169	25.5	26.4	13	22.3	30	71.4	1	5	2	A	1	1	1	2	2	2	2	2
144	1014900	2.7	136	84	0.8	1	8	10	C	24	66.5	173	22.2	23.1	10	20	25	52.3	2	5	2	B	2	2	3,5	2	1	2	1	2
145	1011999	1.61	135	106	0.9	2	3	9	B	16	61.7	170	21.3	24.8	11.5	21.1	28	63.4	1	6	2	A	1	2	3,5	2	1	2	1	2
146	1014915	2.2	129	92	0.65	1	2	10	C	22	58	168	20.54	22.8	11	19.3	18	48.7	2	7	2	B	2	2	3	2	1	2	2	2
147	1010700	1.76	141	108	0.98	2	2	8	B	15	76	182	22.9	26.5	13	22.4	26	56	2	6	2	B	2	2	2	1	2	2	2	2
148	1011331	1.96	131	164	1.19	2	2,3	11	C	22	88.2	181	26.9	26.1	11.5	22.5	29	58.6	2	9	3	B	2	1	1	2	2	2	2	2
149	508342	1.38	135	75	0.74	2	8	7	B	14	81	169	28.3	22.4	8.5	19.8	13	39.7	3	8	2	B	2	2	5	2	2	2	1	2
150	76607	1.58	139	118	0.8	4	8	10	C	18	86	168	30.4	27.2	12	23.5	21	40.44	2	8	2	B	2	2	2,3	1	1	2	2	2
151	985054	1.47	134	52	0.45	4	8	9	B	13	38	154	16.02	16.2	7	14.02	12	51.4	2	9	3	C	3	2	3	2	1	2	2	2
152	989164	1.54	135	107	0.72	2	2	8	B	15	63	175	20.5	23.5	10.4	20.2	22	49.6	2	6	2	B	2	2	2	1	2	2	2	2
153	996177	1.31	135	132	0.62	3	3	8	B	14	76.5	167	27.4	22.3	9.5	19.3	21	35.2	3	8	2	B	2	1	1	2	2	2	2	2
154	1024763	1.06	138	116	1.06	1	2	7	B	9	59	168	20.9	24.5	11	20.04	26	60.2	1	6	2	A	1	1	1	2	2	2	2	2
155	992510	1.34	135	134	0.71	1	8	5	A	10	66.6	172	22.5	28.4	13.2	24.3	16	59.2	2	3	1	A	1	2	5	2	2	2	1	2
156	831715	1.48	136	104	1.31	1	2,3	6	A	12	75	175	24.4	31.2	14.5	26.6	32	75.9	1	4	1	A	1	1	1	2	2	2	2	2
157	789074	1.54	138	62	0.78	2	2,3	7	B	16	68	170	23.5	23.3	10.4	20.1	24	49.8	2	8	2	B	2	1	1	2	2	2	2	2
158	70366	0.85	141	156	1.05	1	3	6	A	9	60	157	24.3	28.3	12.5	24.4	28	76	1	8	2	A	1	1	1	2	2	2	2	2
159	932348	2.39	134	88	0.98	3	3	11	C	22	94	170	32.5	25	10	21.8	17	45.3	2	7	2	B	2	2	2,3,4	1	1	1	2	2
160	784566	1.9	132	117	0.53	3	2	11	C	19	54	154	22.7	20.5	8	17.9	15	54.5	2	8	2	B	2	2	2	1	2	2	2	2
161	1012667	1.8	140	48	0.9	1	2	7	B	15	80	170	27.6	21.4	9.3	18.4	21	48.9	2	5	2	B	2	1	1	2	2	2	2	2
162	1004534	1.9	133	174	0.85	1	2	8	B	20	59.8	170	20.7	24.3	12	20.5	29	61.8	1	2	1	A	1	1	1	2	2	2	2	2
163	1021494	1.72	132	44	0.257	2	8	11	B	21	40.5	154	17.07	20.1	7.8	17.7	10	35.2	3	7	2	C	3	2	3	2	1	2	2	2
164	752659	1.94	140	43	0.75	3	3	10	C	21	57	168	20.2	21.4	8.8	18.6	21	57.2	2	5	2	B	2	1	1	2	2	2	2	2
165	923948	2.01	136	102	0.88	2	3	11	C	20	77	174	25.4	22.4	9	19.6	21	49.6	2	8	2	B	2	2	3	2	1	2	2	2

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Date 8/3/2021

The Principal,
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Subject: Approval of Plan of Thesis.

This is to inform you that the Faculty of Medical Sciences in its meeting held on 22.01.2021 has approved the plan of thesis of Dr Ivan Joshi, a student of your college for DM Medical Gastroenterology along with the names of Supervisor/Co-Supervisor as under:-

Topic Plan of Thesis
Study to compare the prognostic value of various nutritional assessment tools in patients with cirrhosis

Supervisor
Dr. Rajoo Singh Chhina
Prof.,
Dept. of Gastroenterology,
DMCH, Ludhiana.

Co-Supervisor
Dr. Omesh Goyal
Assoc. Prof.,
Dept. of Gastroenterology,
DMCH, Ludhiana.

The student has to submit the three copies of thesis (along with PDF format) , to the Controller of Examinations, BFUHS, Faridkot, at least six months before the commencement of theory examination, if he/she is otherwise eligible to take the examination. He /She must directed to attach a photocopy of this letter with the forwarding letter while submitting thesis to the University along with the letter of approval of University for change of supervisor/Co-Supervisor, change of topic,(if any).

Dr. S P Singh MS(Oph)
Controller of Examinations

Note :
1. If any discrepancy found regarding topic of thesis or Supervisor/Co-Supervisor, inform undersigned within one month after issue of this letter.

STUDY TO COMPARE THE PROGNOSTIC VALUE OF VARIOUS NUTRITIONAL ASSESSMENT TOOLS IN PATIENTS WITH CIRRHOSIS

THESIS PROPOSAL

FOR APPROVAL OF SUBJECT OF THESIS TO BE SUBMITTED

IN PARTIAL FULFILMENT OF THE REQUIREMENTS

FOR THE DEGREE OF

DOCTORATE OF MEDICINE

IN

GASTROENTEROLOGY

OF THE

BABA FARID UNIVERSITY OF HEALTH SCIENCES
FARIDKOT

MARCH, 2020

DR. IVAN JOSHI

DEPARTMENT OF GASTROENTEROLOGY
DAYANAND MEDICAL COLLEGE & HOSPITAL
LUDHIANA

ABSTRACT OF PLAN OF THESIS

Title	STUDY TO COMPARE THE PROGNOSTIC VALUE OF VARIOUS NUTRITIONAL ASSESSMENT TOOLS IN PATIENTS WITH CIRRHOSIS
For the degree of	D.M Gastroenterology
Name of the candidate	Dr. Ivan Joshi
Supervisor	Dr. Rajoo Singh Chhina, Professor, Department of Gastroenterology, DMCH
Co-supervisor	Dr. Omesh Goyal, Associate Professor, Department of Gastroenterology, DMCH
Institution	Dayanand Medical College & Hospital, Ludhiana
University	Baba Farid University of Health Sciences, Faridkot

Introduction: Chronic liver disease involves a process of continuous inflammation and regeneration that results in permanent fibrosis and cirrhosis. Approximately 20% with compensated cirrhosis and 65-95% with decompensated cirrhosis have protein calorie malnutrition. Malnourishment negatively affects immune function, respiratory effort, muscle mass and wound healing. The diagnosis of nutritional state and the treatment of malnutrition in patients with cirrhosis can contribute to a reduction in frequency and severity of complications.

Aim of Study: 1. To assess the nutritional status in patients with cirrhosis by different methods including biochemical parameters, anthropometry, muscle strength assessment and subjective global assessment.

2.To study the correlation of the severity of malnourishment with the severity of liver disease.

3.To study and compare the prognostic value of various nutritional assessment tools with the occurrence of cirrhosis related complications.

Materials & Methods: This prospective study will be conducted among inpatients and outpatients with cirrhosis in Department of Gastroenterology, DMCH, Ludhiana from March 2020 to February 2021 with follow up period of 6 months till August 2021.Based on clinical, biochemical and anthropometirc parameters, patients will be defined as mild, moderate and severe degree of malnutrition. The relation between the nutritional status and the severity of disease will be assessed.

Clinical Significance: The relation between the nutritional status and the severity of disease will be assessed. Nutritional tools will be compared for their validity for prediction of complications of cirrhosis and mortality.

Keywords: cirrhosis, malnutrition, anthropometry.

(Signature)	(Signature)	(Signature)	(Signature)
Candidate	Co-supervisor	Supervisor	Principal

CERTIFICATE OF FACILITIES AVAILABLE

This is to certify that the facilities for work on the subject of thesis titled **"STUDY TO COMPARE THE PROGNOSTIC VALUE OF VARIOUS NUTRITIONAL ASSESSMENT TOOLS IN PATIENTS WITH CIRRHOSIS"** exist in the Department of Gastroenterology, DMC&H, Ludhiana and will be provided to the candidate. We will see that the data being included in the thesis is genuine and is collected by the candidate himself/herself under our supervision and guidance.

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4	DATE OF ADMISSION OF COURSE	2nd Sept 2019
5	TITLE OF THE TOPIC	STUDY TO COMPARE THE PROGNOSTIC VALUE OF VARIOUS NUTRITIONAL ASSESSMENT TOOLS IN PATIENTS WITH CIRRHOSIS

6. BRIEF RESUME OF THE INTENDED WORK

6.1 NEED FOR THE STUDY

Cirrhosis is a chronic parenchymal liver disease, defined histologically as a diffuse hepatic process characterised by fibrosis and the conversion of normal liver architecture into structurally abnormal nodules. In India there was estimated 188,575 cirrhosis related death in 2010 [1] accounting for 18.3% of global burden of cirrhosis related deaths.

Liver is essential in maintaining an appropriate nutritional status in healthy individuals through metabolism of proteins, carbohydrates and fat. In patients with cirrhosis, along with a number of other essential function that liver serves, its role in nutrition maintenance is severely impaired. The most common manifestation of impaired nutritional maintenance in cirrhotics is protein calorie malnutrition, which is independent predictor of mortality [2]. The cause of the morbidity in cirrhotics is multifactorial and one may be attributable to malnourishment.

Although protein calorie malnutrition (PCM) leads to a poor prognosis for the liver patient, it is commonly undiagnosed due to the complications of liver disease such as edema and ascites, which make weight change detection more difficult in this patient population. However, PCM occurs in at least 50% and up to 90% of patients with liver cirrhosis and progresses as liver function deteriorates. Even if PCM is diagnosed in a patient, its importance is often underestimated by the physician and it is not considered a medical problem in need of immediate attention. However, it is important to note that malnutrition is an independent risk factor for predicting clinical outcomes in patients with liver disease and is associated with an increased risk of morbidity, mortality, biochemical dysfunction, compromised immune function, respiratory function, decreased muscle mass, increased recovery time and delayed wound healing.

Chronic liver disease involves a process of continuous inflammation and regeneration that eventually results in permanent fibrosis and cirrhosis. Most common causes of this condition include alcoholic liver

disease, Hepatitis C and B infection and NAFLD. Of those affected by CLD, approximately 20% with compensated cirrhosis and 65-95% with decompensated cirrhosis have protein calorie malnutrition.[3] The quality of life is abysmal with end stage cirrhosis per se and it is further worsened by complication like infection especially SBP, GI Bleed, encephalopathy, renal failure and other complications.[4] Higher degree of malnutrition is associated with lower quality of life.[5] Each of these complications aggravates the catabolic state by their impact on circulating cytokines and hormones and results in the reduction of muscle mass. Development of portal hypertension, portosystemic collaterals, and varices are more severe and common in malnourished patients. However, few studies have systematically evaluated the impact of malnutrition on the development and progression of these complications.

Major nutrient deficient is protein in cirrhotics [6], though trace elements and vitamins deficiency also are quiet common. Body composition is also altered in chronic liver disease wherein extracellular fluid volume expands and intracellular fluid volume contracts.[7] Men are more prone for malnourishment, an effect hypothesised due to low testosterone in cirrhosis. Alcoholic cirrhotics are more undernourished than post necrotic cirrhosis patients. Reported rates are between 20% for patients with compensated cirrhosis to 100% in hospitalised patients with acute alcoholic hepatitis superimposed on cirrhosis.[8] In patients with cirrhosis, the prevalence of malnutrition characterized by loss of lean body mass and diminished skeletal muscle weight is estimated to be between 20% to 60% in different studies.[9] Differences in the cause and severity of disease affect the estimated prevalence of malnutrition in cirrhosis.[10] Prevalence of malnutrition depends primarily on the definition chosen, cause of the liver disease, the stage of the disease, and the methods used to quantify malnutrition.

Malnourishment negatively affects immune function, respiratory effort, muscle mass, wound healing. Death rate is high in overly malnourished. Increased rates of septic complications, poorer quality of life and a reduced lifespan have all been observed in cirrhotics with

poorer nutrition status compared to those without. The diagnosis of nutritional state and the treatment of malnutrition in patients with cirrhosis can contribute to a reduction in frequency and severity of complications.[3]

The aim of this present study is to assess, by different assessment methods of the nutritional state, the frequency of malnutrition in Cirrhotic patients and to relate the diagnosis of malnutrition with the severity and etiology of hepatic disease and outcome.

6.2 REVIEW OF LITERATURE

Malnutrition is prevalent in all forms of liver disease: from 20% in compensated liver disease to more than 80% in those patients with decompensated liver disease.[11] Protein-calorie malnutrition (PCM) can be identified in all clinical stages but is easier observed in advanced stages of liver disease. [12] Many patients have subtle changes such as fat-soluble vitamin deficiency, altered cell-mediated immune function, anemia from iron, folate or pyridoxine deficiency and minimal loss of muscle mass. Patients with end-stage liver disease have muscle wasting, decreased fat stores and cachexia.

Malnutrition also has important implications in liver transplantation and it has been demonstrated that patients with a worse nutritional status before the transplant have increased postoperative complications and higher mortality rates.[13]

There are a number of factors that contribute to malnutrition in patient with liver disease.Causes of malnutrition in cirrhosis are known to include a reduction in oral intake, increased protein catabolism and insufficient synthesis and malabsorption associated with portal hypertension. Low dietary intake may be due to dyspepsia, ascites, altered mental state/encephalopathy, gastroparesis, restrictive diet (low sodium, low protein, fluid restriction), dysgeusia (zinc deficiency), alcohol intake, socioeconomic status and increase in leptin. Other causes include enteral protein loss and hypercatabolism.

Liver in health has a synthetic function of albumin, globulin and fibrinogen synthesis. Ammonia production by deamination of amino acids and subsequent conversion to urea occurs exclusively in liver. Amino acids in liver take part in production of glutathione and creatine, an important energy source in skeletal muscles. In cirrhotics, gluconeogenic amino acids glutamine and alanine are provided by proteolysis in skeletal muscle, which also contributes to the muscle wasting. Thus, there is protein catabolism, decreased urea synthesis, and increased branched chain amino acid utilisation for ketogenesis. Hypertriglyceridemia is the most common lipid abnormality in cirrhosis, due to increased fatty acid production and decreased beta oxidation.

Fat soluble vitamins are deficient because of the decreased synthesis of carrier and transport proteins by liver.

Considering that protein calorie malnutrition and micronutrient deficiencies have major prognostic implications in patients with CLD, it is essential to effectively and regularly assess nutritional status. It well correlates with short and long term mortality, severity of liver disease apreciated by Child-Pugh classification (CP) and Model for End Stage Liver Disease (MELD), liver graft and patient survival after liver-transplantation.[14] Multiple factors need to be analysed in order to make a comprehensive nutritional assessment. Many methods of assessment of nutritional status have been developed to identify malnourished patients or the risk for malnutrition.

The BMI is well known anthropometric measure that is basic in assessment of nutritional state of healthy and diseased persons. It is a cheap and convenient objective tool dependent on height and weight. But, presence of cirrhosis and edema make it non accurate tool as it overestimate the actual body mass. Cirrhotic patients are volume overloaded; hence mere weight or BMI may not bring out the malnourishment to clinician's view. BMI may be normal (18.5 to 23.5) in the setting of ascites and edema. Campillo et al [15] found that cut off for BMI in identifying malnourishment in cirrhosis if below 22 in the absence of ascites, below 23 in the presence of moderate ascites, and below 25 Kg/m2 in the setting of massive ascites. This cut off has not been validated by others, and varies in different racial background. In a study by Vishnu et al, BMI showed no significant difference and it was in the normal range even though the patients were malnourished. In a study by Mei-Ling S tai et al [16], BMI measurements in less malnourished cirrhotic patients were not different from general population, mainly due to the fact that ascites and peripheral edema contributed significantly to body weight.

It is always difficult to accurately quantify the nutritional intake in patients; however there are tools available for the purpose. 24 hour recall, food frequency questionnaire, calorie count and food dairy are some of them. None of them have been validated.

Subjective global assessment (SGA) is one of the most popular method used in evaluation of nutritional state in hospitalized patients. The use of the SGA was recommended by the 2006 guidelines of the European Society of enteral and parenteral Nutrition (ESPEN) together with anthropometric analysis and handgrip strength test (HGS) for identifying patients with cirrhosis who are at risk of malnutrition. SGA is a standardised array of questions and physical exam findings that are collectively scored to provide a comprehensive rating of nutritional status.[16] Patients are graded into well nourished, moderately malnourished and severely malnourished. In a study by Hassan et al [17], 64.4 % of studied patients were malnourished by SGA and class A of SGA was more prevalent in Child A, however class B and C were more in Child C, with significant difference between Child A and B, and Child A and C. In a study by Patricia et al [18], 61.5% patients were diagnosed with malnutrition, of which 41% had moderate malnutrition and 20.5 % had severe malnutrition.

Triceps skin fold thickness (TSFT) or sub scapular fold thickness is measured as a surrogate marker of subcutaneous fat thickness [19]. Skin fold thickness is measured using specially designed callipers.

Mid Arm Muscle Circumference (MAMC) measures the skeletal muscle mass approximately. However confounding factors of gender and different humerus diameter has to be taken in to account and it is not an accurate predictor of malnutrition when taken as a lone parameter[20]. MAMC is measured from Mid Arm Circumference (MAC) and Triceps Skin fold thickness (TSFT) using the following formula.

MAMC = MAC - (0.314 x TSFT)

MAMC and TSFT values less than 5th percentile for a population is considered abnormal and used in diagnosis of malnutrition.

Hand Grip Dynamometry, measured using a hand held Dynamometer- digital or analogue- in units of Kilogram per Force, is an excellent tool in determining depleted fat free mass in cirrhosis. It requires a little alert and co-operative patient [21]. In a study by Alvaresda Silva et al [22], HG was found to be more sensitive than SGA in predicting malnutrition and the incidence of major complications at 1 year in cirrhotic patients.

Creatinine Height Index is calculated as amount of 24 hour urine creatinine, corrected for patient's height accurately assesses the skeletal muscle mass. Values that are less than 20% of normative values are suggestive of severe Protein Calorie Malnourishment.

Controlling nutritional status (CONUT) consists of three parameters, serum albumin, cholesterol, and total lymphocytic count. Nutritional status assessed by CONUT is classified into four grades of severity: no, mild, moderate and severe malnutrition. A study by Cholongitas et al [23] considered the value of CONUT closely associated with severity of chronic liver disease, and one of the most predictive factors for prognosis in cirrhotic patients.

Cirrhosis is prognostically classified based on Child Turcotte Pugh Score into CTP A, CTP B and CTP C, based on bilirubin, ascites, albumin, prothrombin time and hepatic encephalopathy. MELD score is also used to classify the severity of liver cirrhosis. Abbott et al [24] investigated the relationship between the Child Pugh classification and nutritional indicators and found that advanced liver disease (CTP score) was associated with diminished muscle status and increased malnutrition. Nutritional status could be a useful addition to the Child Pugh classification when assessing the prognosis of cirrhotic patients.

Metabolic dysregulation and malnourishment in cirrhosis is a common entity, and it negatively impacts the course of complication and mortality in Cirrhosis. Malnutrition is associated with poor prognosis of cirrhotic patients. It results in higher complication rates like ascites, encephalopathy, infections, and kidney injuries. These often lead to increased mortality to the tune of 48% vs 18% respectively in cirrhotics with and without malnutrition. The degree and prevalence of malnutrition is generally directly proportional to the disease severity, being higher in decompensated cirrhosis.[4] Early identification can be helpful in providing medical nutritional therapy in cirrhosis, thereby reducing the morbidity and mortality.

6.3 AIMS AND OBJECTIVES OF THE STUDY

- To assess the nutritional status in patients with cirrhosis by different methods including biochemical parameters, anthropometry, muscle strength assessment and subjective global assessment.
- To study the correlation of the severity of malnourishment with the severity of liver disease.
- To study and compare the prognostic value of various nutritional assessment tools with the occurrence of cirrhosis related complications.

7.0 MATERIALS AND METHODS

7.1 SOURCE OF DATA:

This is a prospective study to be conducted from March 2020 to February 2021 with follow up till August 2021 among inpatients and outpatients in the department of Gastroenterology.

7.2 METHOD OF COLLECTION OF DATA

Inclusion Criteria

- Age 18-65 years of age
- Cases of cirrhosis, diagnosed by clinical, biochemical and imaging parameters, of all etiologies

Exclusion criteria

- Hepatic encephalopathy
- Active gastrointestinal bleeding
- Sepsis
- Acute liver failure
- Suspected hepatocellular carcinoma
- Chronic diarrhoea
- Chronic kidney disease
- Patients with chronic debilitating diseases and malignancies

All consecutive patients diagnosed with cirrhosis will be enrolled. Baseline demographic values will be recorded; haematological and biochemical parameters will be noted. Severity of liver disease will be determined by CTP score and MELD. CTP score is based on five parameters: serum bilirubin, serum albumin, ascites, encephalopathy and prothrombin time. MELD (Model for end stage liver disease) score includes bilirubin levels, INR, serum creatinine and serum sodium. Anthropometric measurements including height, weight and BMI will be recorded.

Nutritional status will be determined for each patient by means of:

I. Anthropometric measurement:

a) Mid arm circumference: measured with inch tape at a midpoint between acromian process and olecranon in the relaxed non dominant arm

b) Triceps skin fold thickness measured with callipers

c) MAMC: Mid arm muscle circumference calculated by using the formula MAMC = MAC in cm - (TSFT in mm x 0.314)

MAMC and TSFT Values less than 5th percentile for a population is considered abnormal and used in diagnosis of malnutrition.

d) BMI: calculated as Weight (in Kg)/height (in metres^2) corrected for overweight estimation due to ascites, dry BMI will be interpreted to have under nutrition as follow; No ascites, BMI ≤ 22 kg/m2, Mild ascites, BMI ≤ 23 kg/m2, Tense ascites, BMI ≤ 25 kg/m^2.

II. Hand grip strength: It will be assessed with hand grip dynamometer. HGS will be measured with the subject in the seated position, shoulders adducted and neutrally rotated, elbow flexed at 90° with the forearm and wrist in a neutral position. Every patient will squeeze the dynamometer with as much force as possible, 3 trials will be performed on dominant hand and the average of the measurements will be used for comparison with age- and sex-adjusted standards. Average of three readings taken at an interval of 5 minutes will give final value expressed in Kg/F.

III. Creatinine–height index (CHI): 24 hour urinary creatinine will be measured and compared with the values expected for the same height. The results will be interpreted as follows:

a) CHI ≥ 80%: normal protein status

b) CHI 60-80%: mild protein depletion

c) CHI 40-60%: moderate protein depletion

d) CHI <40%: severe protein depletion

IV. Controlling nutritional status (CONUT): It consists of three parameters, serum albumin, cholesterol, and total lymphocytic count. Nutritional status assessed by CONUT is classified according to the total score into four degrees of severity: no malnutrition: 0-1, mild malnutrition: 2-4, moderate malnutrition: 5-8, and severe malnutrition: 9-12.

V. Subjective Global Assessment score: The features of SGA are history, physical evaluation and SGA rating. The history includes weight change, dietary intake, gastrointestinal symptoms, and

functional capacity of work. Physical examination includes detection of ankle oedema and ascites. All patients will be classified into SGA A, SGA B, or SGA C based on the score. SGA 'A' is well nourished, 'B' is mild to moderately malnourished and 'C' is severely malnourished.

Based on anthropometric, biochemical, muscle strength assessment and subjective global assessment, patients with cirrhosis will be defined as mild, moderate and severe degree of malnutrition. The relation between the nutritional status and the severity of disease will be assessed. Patients will be followed for 6 months for development of cirrhosis related complications and mortality. Nutritional tools will be compared for their validity for prediction of complications of cirrhosis and mortality.

Type of study: Prospective study

Duration of Study: March 2020 to February 2021 with follow up period of 6 months till August 2021

OUTCOME: Malnutrition is associated with more advanced stage of chronic liver disease and higher complication rate.

STATISTICAL ANALYSIS: Data will be described in terms of range; mean ±standard deviation (± SD), median, frequencies (number of cases) and relative frequencies (percentages) as appropriate. Comparison of quantitative variables between the study groups will be done using ANOVA . For comparing categorical data, Chi square ($\chi 2$) test will be performed and exact test will be used when the expected frequency is less than 5.A probability value (p value) less than 0.05 will be considered statistically significant. All statistical calculations will be done using SPSS (Statistical Package for the Social Science) SPSS 21 version statistical program for Microsoft Windows.

7.3 DOES THE STUDY REQUIRE ANY INVESTIGATIONS OR INTERVENTIONS TO BE CONDUCTED ON PATIENTS OR OTHER HUMANS OR ANIMALS? IF SO, PLEASE DESCRIBE BRIEFLY.

NO

7.4 HAS ETHICAL CLEARENCE BEEN OBTAINED FROM YOUR INSTITUTION IN CASE OF 7.3?

ATTACHED HEREWITH

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PROFORMA

Name: Sr. No

Address: Age/Sex:

Contact No.:

DOA: DOD:

Presenting complaints: Symptoms Duration

1)

2)

3)

Past History:

CLD: Duration:

DM:

HTN:

Others:

Personal History:

Alcohol: Yes/No Duration:

Smoking: Yes/No Duration:

IVDU: Yes/No Duration:

Others:

Signature of Candidate

Signature of Supervisor

Diagnosis:

Etiology:

CTP Score:

MELD score:

Investigations:

Hb:

TLC:

Platelet:

INR:

Bilirubin(T):

(D):

Protein(T):

Albumin:

Urea:

Creatinine:

Lipid profile: (Total cholesterol)

24 hour urinary creatinine:

Ascitis:

USG Abdomen:

UGIE:

Anthropometry:

Weight:

Height:

BMI:

Mid Arm circumference:

Triceps skin fold thickness (TSFT):

Signature of Candidate

Signature of Supervisor

Mid Arm Muscle Circumference (MAMC):

Hand Grip Strength (average of 3 reading):

CHI:

CONUT:

Subjective Global Assessment:

Follow up at 6 months:

Complication:

SBP	HE	HRS
UGIB	HCC	None

Signature of Candidate

Signature of Supervisor

Subjective Global Assessment

Name:
Date:

Medical History			A	B	C
WEIGHT					
Wt change past 6 months	Usual weight.....	Current weight.....			
	Amount weight loss.....	% weight loss.....			
0-<5% loss			•		
5-10% loss				•	
>10% loss					•
Weight change past 2 weeks		Amount.....			
No change; normal weight			•		
Increase to within 5%			•		
Increase (1 level above)			•	•	
No change, but below usual wt				•	
Increase to within 5-10%				•	
Decrease					•
DIETARY INTAKE					
No change; adequate			•		
No change; inadequate				•	
Change	**Duration of change**.....				
Suboptimal diet				•	
Full liquid				•	
Hypocaloric liquid					•
Starvation					•
Intake borderline; increasing			•		
Intake borderline; decreasing				•	
Intake poor; no change				•	•
Intake poor; increasing				•	
Intake poor; decreasing					•
GASTROINTESTINAL SYMPTOMS	Frequency (never, daily, no. of times/week)	Duration (<2wk, >2wk)			
Nausea	.....	.....			
Vomiting	.....	.....			
Diarrhoea	.....	.....			
Anorexia	.....	.....			
None; intermittent			•		
Some (daily >2 week)				•	
All (daily >2 week)					•
FUNCTIONAL CAPACITY					
No dysfunction	Duration of change		•		
Difficulty with ambulation/normal activities				•	
Bed/chair-ridden					•
Change past 2 week					
Improved			•		
No change				•	
Regressed					•

Signature of Candidate

Signature of Supervisor

Subjective Global Assessment

Name:
Date:

Medical History			A	B	C
WEIGHT	Usual weight.....	Current weight.....			
Wt change past 6 months	Amount weight loss.....	% weight loss.....			
0-<5% loss			•		
5-10% loss				•	
>10% loss					•
Weight change past 2 weeks		Amount.....			
No change; normal weight			•		
Increase to within 5%			•		
Increase (1 level above)			•	•	
No change, but below usual wt				•	
Increase to within 5-10%				•	
Decrease					•
DIETARY INTAKE					
No change; adequate			•		
No change; inadequate				•	
Change		**Duration of change**.....			
Suboptimal diet				•	
Full liquid				•	
Hypocaloric liquid					•
Starvation					•
Intake borderline; increasing					
Intake borderline; decreasing			•		
Intake poor; no change				•	
Intake poor; increasing				•	•
Intake poor; decreasing				•	
GASTROINTESTINAL SYMPTOMS	Frequency (never, daily, no. of times/week)	Duration (<2wk, >2wk)			
Nausea	.....	.....			
Vomiting	.....	.....			
Diarrhoea	.....	.....			
Anorexia	.....	.....			
None; intermittent			•		
Some (daily >2 week)				•	
All (daily >2 week)					•
FUNCTIONAL CAPACITY					
No dysfunction		Duration of change	•		
Difficulty with ambulation/normal activities				•	
Bed/chair-ridden					•
Change past 2 week					
Improved			•		
No change				•	
Regressed					•

Signature of Candidate

Signature of Supervisor

Physical examination	A	B	C
SUBCUTANEOUS FAT			
Under the eyes	Slightly bulging area		Hollowed look, depression, dark circles
Triceps	Large space between fingers		Very little space between fingers, or fingers touch
Biceps	Large space between fingers		Very little space between fingers, or fingers touch
MUSCLE WASTING			
Temple	Well-defined muscle/flat	Slight depression	Hollowing, depression
Clavicle	Not visible in Males; may be visible but not prominent in females	Some protrusion; may not be all the way along	Protruding/prominent bone
Shoulder	Rounded	No square look; acromion process may protrude slightly	Square look; bones prominent
Scapula/ribs	Bones not prominent; no significant depressions	Mild depressions or bone may show slightly; not all areas	Bones prominent; significant depressions
Quadriceps	Well rounded; no depressions	Mild depression	Depression; thin
Calf	Well developed		Thin; no muscle definition
Knee	Bones not prominent		Bones prominent
Interosseous muscle between thumb and forefinger	Muscle protrudes; could be flat in females		Flat or depressed area
OEDEMA (related to malnutrition)	No sign	Mild to moderate	Severe
ASCITES (related to malnutrition)	No sign	Mild to moderate	Severe
OVERALL SGA RATING	**A**	**B**	**C**

Adapted from: Detsky et al., 1994[8]; Baxter Healthcare Corporation, 1993; McCann, 1996 (Ferguson, Bauer, Banks, Capra, 1996)©

Signature of Candidate

Signature of Supervisor

INFORMED PATIENT CONSENT

Date: _____

I.....D/o, W/o, S/o.....
.....am willing to participate in the study **"STUDY TO COMPARE THE PROGNOSTIC VALUE OF VARIOUS NUTRITIONAL ASSESSMENT TOOLS IN PATIENTS WITH CIRRHOSIS"** The procedure with its complications has been explained to me in local vernacular language. I have fully understood that no special tests and extra expenditure in any form, merely for the purpose of thesis is being carried out. I am free to opt out the study any time without assigning any reason.

....
Signature of the Witness Signature of the patient

Name:

Signature of Candidate **Signature of Supervisor**

मरीज अनुमति फार्म

तिथि _____

मैं _____ पत्नी/पुत्र/पुत्री _____

निवासी _____

इस शोधकार्य **"STUDY TO COMPARE THE PROGNOSTIC VALUE OF VARIOUS NUTRITIONAL ASSESSMENT TOOLS IN PATIENTS WITH CIRRHOSIS"** में भाग लेने के लिए सहमत हूँ। मैं इस शोधकार्य में भाग लेने के लिए अपनी स्वेच्छा से तैयार हूँ। मैं पुष्टि करता/करती हूँ की यह स्वीकृति देने के लिए मुझे कोई आर्थिक प्रलोभन नहीं दिया गया और न ही दबाव डाला गया है। मुझे इस शोधकार्य का उद्देश्य स्पष्ट कर दिया गया है और मुझे यह विश्वास है की यह विज्ञान और मानवता के लाभ के लिए है। मुझे इस शोधकार्य में होने वाले जोखिम के बारे में समझा दिया गया है और मेरी समझ में यह जोखिम बहुत मामुली है।

मैं इस शोधकार्य में भाग लेने के सम्बन्ध में किसी भी समय अपनी अस्वीकृति व्यक्त कर सकता/सकती हूँ और मेरे अस्वीकृति व्यक्त करने का मेरे इलाज पर कोई प्रभाव नहीं पड़ेगा।

_____ _____

गवाह के हस्ताक्षर रोगी के हस्ताक्षर/अंगूठे का निशान

नाम: नाम:

_____

अन्वेषक के हस्ताक्षर

_____

विद्यार्थी के हस्ताक्षर

ਮਰੀਜ਼ ਰਜ਼ਾਮੰਦੀ ਫਾਰਮ

ਮਿਤੀ_____

ਮੈ_____ਪਤਨੀ/ਪੁੱਤਰ/ਪੁੱਤਰੀ_____

ਵਾਸੀ _____

"STUDY TO COMPARE THE PROGNOSTIC VALUE OF VARIOUS NUTRITIONAL ASSESSMENT TOOLS IN PATIENTS WITH CIRRHOSIS" ਤੇ ਚਲ ਰਹੀ ਖੋਜ ਵਿਚ ਹਿੱਸਾ ਲੈਣ ਲਈ ਰਜ਼ਾਮੰਦ ਹਾਂ। ਇਸ ਖੋਜ ਕੰਮ ਵਿਚ ਹਿੱਸਾ ਲੈਣ ਲਈ ਮੈ ਆਪਣੀ ਮਰਜ਼ੀ ਨਾਲ ਤਿਆਰ ਹਾਂ। ਮੈ ਇਹ ਦਸਣਾ ਚਾਹੁੰਦਾ ਹਾਂ/ ਚਾਹੁੰਦੀ ਹਾਂ ਕੇ ਇਹ ਰਜ਼ਾਮੰਦੀ ਦੇਣ ਵਾਸਤੇ ਮੈਨੂ ਕਿਸੇ ਵੀ ਤਰਾਂ ਦਾ ਲੋਭ-ਲਾਲਚ ਨਹੀ ਦਿੱਤਾ ਗਿਆ ਅਤੇ ਨਾ ਹੀ ਕੋਈ ਦਬਾ ਪਾਇਆ ਗਿਆ ਹੈ। ਮੈਨੂ ਇਸ ਖੋਜ ਦਾ ਮਨੋਰਥ ਸਮਝਾ ਦਿੱਤਾ ਗਿਆ ਹੈ ਅਤੇ ਮੈਨੂ ਇਹ ਭਰੋਸਾ ਦਵਾਇਆ ਗਿਆ ਹੈ ਕੇ ਇਹ ਖੋਜ ਵਿਗਿਆਨ ਅਤੇ ਮਾਨਵਤਾ ਦੀ ਭਲਾਈ ਲਈ ਹੈ। ਮੈਨੂ ਇਸ ਖੋਜ ਵਿਚ ਹੋਣ ਵਾਲੇ ਖਤਰੇ ਬਾਰੇ ਸਮਝਾ ਦਿੱਤਾ ਗਿਆ ਹੈ ਅਤੇ ਮੈਨੂ ਇਹ ਯਕੀਨ ਹੈ ਕੇ ਇਹ ਖਤਰਾ ਬਹੁਤ ਮਾਮੂਲੀ ਹੈ। ਮੈਨੂ ਇਸ ਖੋਜ ਕੰਮ ਵਿਚ ਹਿੱਸਾ ਲੈਣ ਦਾ ਢੰਗ – ਤਰੀਕਾ ਸਮਝਾ ਦਿੱਤਾ ਗਿਆ ਹੈ।

ਮੈ ਇਸ ਖੋਜ ਕੰਮ ਵਿਚ ਹਿੱਸਾ ਲੈਣ ਬਾਰੇ ਆਪਣੀ ਰਜ਼ਾਮੰਦੀ ਕਿਸੇ ਵੀ ਸਮੇ ਵਾਪਸ ਲੈ ਸਕਦਾ ਹਾਂ/ ਸਕਦੀ ਹਾਂ ਅਤੇ ਮੇਰੀ ਰਜ਼ਾਮੰਦੀ ਵਾਪਸ ਲੈਣ ਦਾ ਮੇਰੇ ਇਲਾਜ ਤੇ ਕੋਈ ਅਸਰ ਨਹੀ ਹੋਵੇਗਾ।

_____ _____

ਗਵਾਹ ਦੇ ਹਸਤਾਖਰ ਮਰੀਜ਼ ਦੇ ਹਸਤਾਖਰ

ਮਿਤੀ_____ ਮਿਤੀ_____

ਪਤਾ _____ ਪਤਾ _____

_____

ਨਿਰੀਖਕ ਦੇ ਹਸਤਾਖਰ

_____

ਸਿਖਿਆਰਥੀ ਦੇ ਹਸਤਾਖਰ